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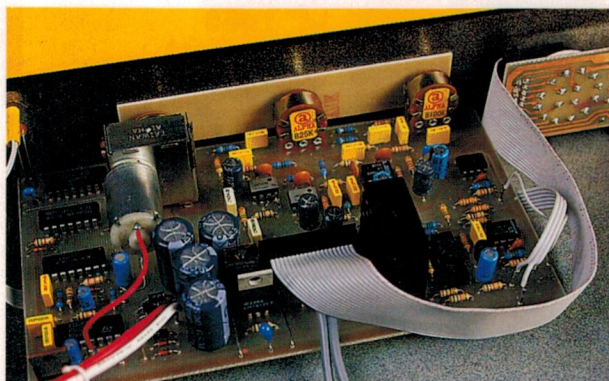
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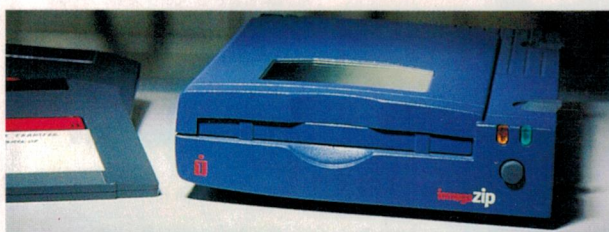
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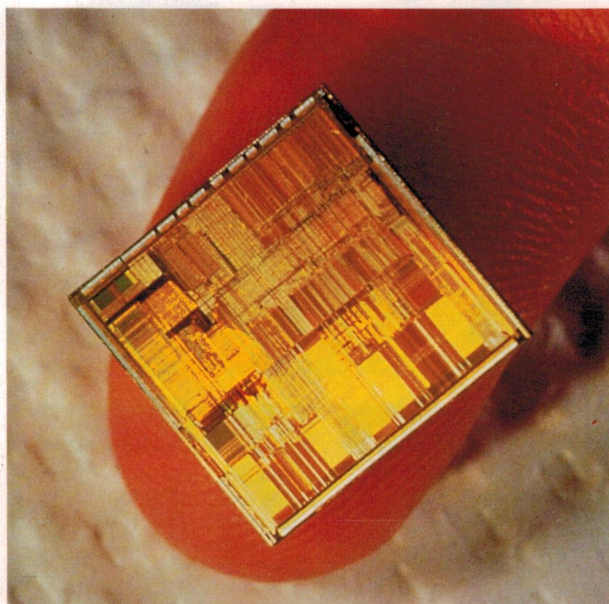
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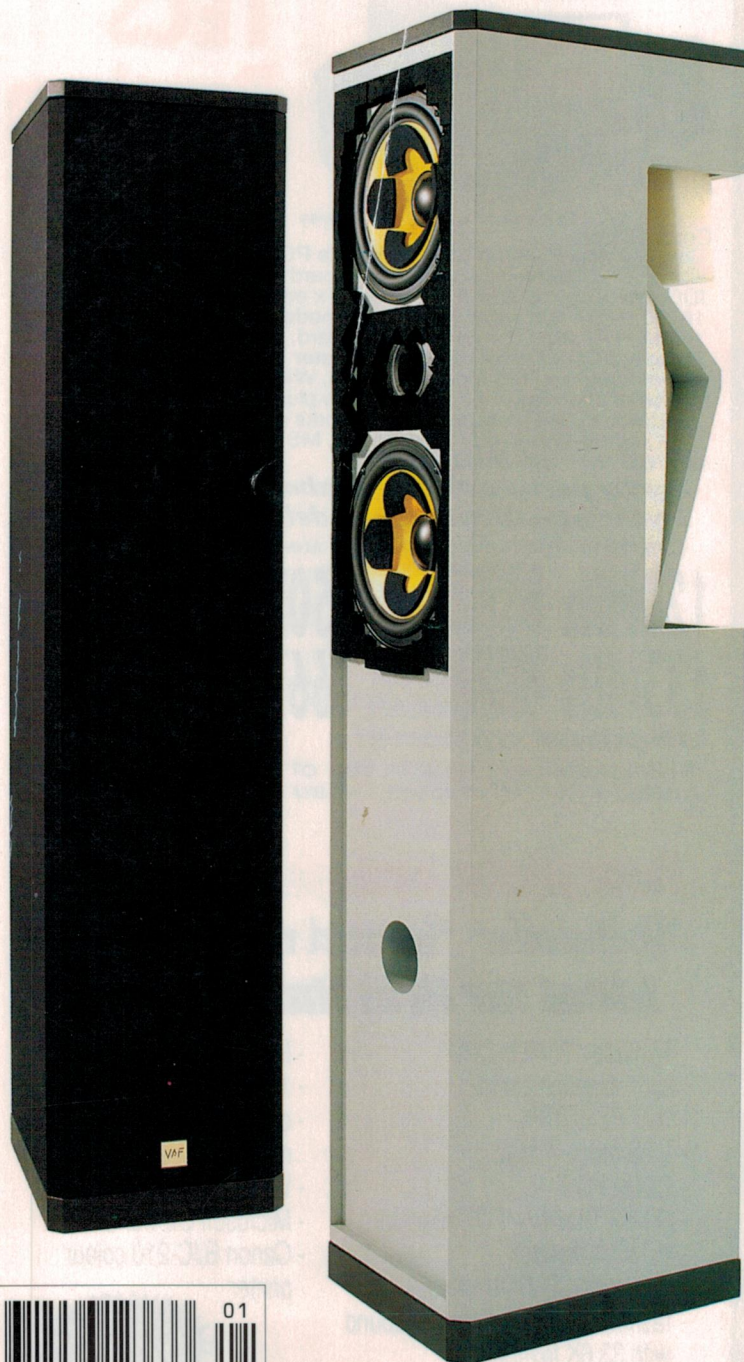
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**READER INFO NO. 2**

# Electronics

Volume 59, No.1  
January 1997

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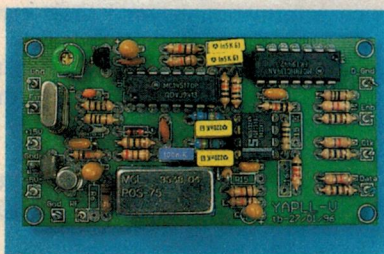
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## Tunes up to 2GHz



Icom's new IC-R8500 Communications Receiver tunes all the way from 100kHz up to 1999.9999MHz, and offers a broad selection of receiving modes — plus 1000 memories, IF shift and a tuneable audio peaking filter. It can also be hooked up to a PC, as we mention in our review starting on page 8.

## Programmable PLLs



Need to generate VHF or UHF signals at accurately programmed frequencies? Designer Tibor Becs has developed some low cost PLL modules which can be used either alone, or in conjunction with his YADDS-1 digital synthesiser module to do the job under PC control. See his article starting on page 82...

## On the cover

VAF's new DC-X kit speakers use a 'no crossover' design, and give a very impressive performance (page 72); the mighty micro has just turned 25, as Paul Swart explains in our story starting on page 28; Rob Evans tells how to build his new Playmaster Four Preamp (page 56); and our Zip 100 drive review starts on page 112.

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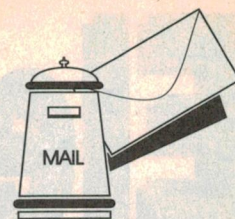
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# LETTERS TO THE EDITOR



## Mouse problems

I read with interest the published letter from Mr Clive Luckman of Middle Park, Victoria (EA September 1996), and would like to add some comments relevant to 'PC interference' and mouse cables.

Westinghouse Industrial Products is the Australian importer and distributor of the Schaffner range of power line filters and interference simulation test equipment. One of our customers is a major Australian financial institution and has a very extensive technical evaluation programme for the large number of PCs which it purchases by tender.

However they found a fairly high failure rate with one particular batch of computers. On verifying the original tests, it was found that relatively low levels (several hundred volts) of electrostatic discharge (ESD) applied to the mouse cable caused hardware failures.

On close investigation it was found that the manufacturer of the mouse cable had decided that a shielded cable was no longer required. The original batch of PCs that were tested at the tender evaluation phase did pass the ESD test programme.

It seems some mouse cables are shielded and others not.

One would hope that the new mandatory EMC standards for electronic equipment will rectify these sorts of problems. Your readers could well be advised to look out for the new 'C-Tick' mark when making purchases.

**John Thompson, Sales Manager  
Westinghouse Industrial Products  
South Melbourne, Vic.**

## RPI modems

Tom Moffat's article on the shortcomings of the new RPI modems (EA November 1996, pages 30-32) was an eyeopener. I would like to add that one needs to be particularly careful when buying or upgrading to a new computer system. Some cheap motherboards on the market do not allow more than two serial I/O ports.

I once bought a no-name 14,400b/s internal modem and found that I could not run my mouse and the modem running under Windows 95, as the hard-

ware wizard had gobbled TWO ports, leaving none for my mouse. (One port was for the modem and one port for the serial software driver.) I have since invested in a better motherboard and a new modem.

My new modem is a 28,800b/s Creative Labs Modemblaster (External) which is great and well worth the money. My old 14,440b/s internal modem seems to work quite well with my old DX486/66 computer however, and is OK for the Internet if I turn off the images!

In general however, to anyone contemplating buying a new modem who has Windows 95, get an external model — internal modems are just are not worth the trouble.

**Robert Hunter, WA  
(Via the BBS)**

## Lack of support

Any of your readers contemplating the purchase of CB radio equipment may not be aware that Uniden will not supply service information beyond their own service network.

In some cases competitors' products may cost a few dollars more, but the ones I prefer to support are certainly a lot more DIY friendly.

I don't have any particular axe to grind, being an ex-tech who tries to keep his hand in.

**John Harvey,  
Clermont, Qld.**

## Expression of sympathy

On behalf of Alf Forster, President of the Victorian Division of TETIA, and our members, I would like to convey our deepest sympathy and regret that Neville Williams is no longer able to provide us with more words of wisdom. Our members have enjoyed reading and learning from his writing for as many years as we can possibly remember. He will be greatly missed by our members, and all readers of *Electronics Australia*.

With reference to Neville's recent biography of Max Howden, I have had the pleasure of knowing John Howden for many years. I believe that this story would not be complete without some acknowledgement of John's contribu-

tion to the Electronics Service industry.

John was a founder member of TETIA in 1956 and served as an active committee member until late in the 1980s. He was awarded a Life Membership of TETIA on his retirement.

John had his own service business when I first met him, and later became workshop foreman with Hill's Television Service. He has always been most helpful in training newcomers to the industry, and in particular those valuable apprentices. It is not possible in a few words to detail all that he has done and accomplished for the members of TETIA and the industry. Of course he was/is an active Amateur Radio Operator.

I trust that this information adds to Neville's story.

**Leon Aarons LMTETI(Aust.)**  
**Knoxfield, Vic**

### Happy winner

I am writing to thank your magazine and Allthings Sales & Service for the miniature CCD Video Camera I won as a result of my contribution to the Circuit & Design Ideas section in the October issue.

I have always wanted one, and may use it as a surveillance camera for the carpark in my block of flats, to keep an eye on things at night. Thanks again!

**Kerry Helman,**  
**Salisbury North, SA.**

### Impressed with ESR meter

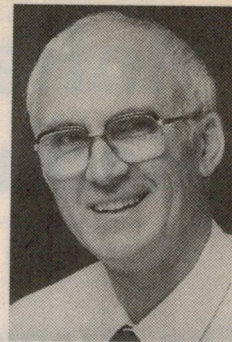
As a technical teacher for several years, I was aware of technological advances in many areas of electronics. However I was unaware of component reliability in CTVs and VCRs. A few years ago I returned to my own company operations and found the repairs of CTVs and VCRs compounded by poor electrolytic component reliability.

Your article (January 1996) describing the ESR & Low Ohms Meter has been a watershed in electronics repair. I doubt that any instrument designed has ever had such an impact on my time and component management, as this meter. My congratulations to the designer and the magazine for an outstanding achievement.

**A.R. Hoy,**  
**Currimundi, Qld. ♦**

Letters published in this column express the opinions of the correspondents concerned, and do not necessarily reflect the opinions or policies of the staff or publisher of Electronics Australia. We welcome contributions to this column, but reserve the right to edit letters which are very long or potentially defamatory.

## EDITORIAL VIEWPOINT



### ***Broadband communications: plenty of challenges ahead...***

Welcome to our first issue for 1997, and I trust you'll find plenty of interesting reading inside. There's no doubt that one of the most dynamic areas in modern electronics and information technology is broadband communications. Only a few years ago it seemed to consist of little more than 'blue sky' predictions about the future, by enlightened telecomms and computer experts; now it's rapidly becoming a reality, and at an ever-accelerating pace.

A lot of the impetus is coming from the almost explosive growth of the Internet and its offshoot the World Wide Web, of course. Although many people are first attracted to the Web as a result of media hype and 'free trial' offers by Internet access providers, it generally doesn't take long to discover the Net's positive benefits, and start taking them for granted.

Once you've discovered the speed and convenience of e-mail, for example, the prospect of losing it again seems like a return to the dark ages. Similarly once you've discovered how easy it is to use the Web to retrieve information like technical specifications, device data sheets, software and so on — from all over the world, in just a few minutes — there's no way you'd want to be deprived of this important research tool. And once you've seen a demonstration of international video conferencing, you *really* start to grasp the Net's future potential...

Clearly, though, this incredible growth in Internet usage has already placed a big strain on the telecomm infrastructure, even in developed countries like Australia and the USA. Hence the almost feverish activity to upgrade existing networks, to develop interim 'speedup' technology and to roll out technology which allows HFC cable networks to provide both conventional telephony and wideband services.

We're certainly entering an incredibly exciting new communications era, and for the next few years at least the developments are going to come at a bewildering rate. It's all going to present innumerable challenges — for the telco's, to keep up with the ever-expanding demand for system bandwidth; for companies developing the broadband modems and similar comms hardware, to increase throughput and reliability while driving down costs; for information and service providers, to work out how to supply all of the information that people want, in a profitable way; and of course for all of us, to understand what's happening and it all works.

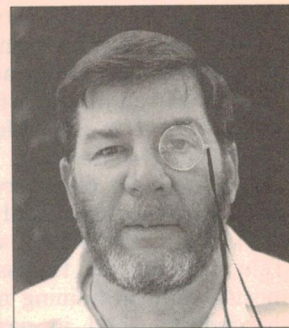
Needless to say, we'll be doing our best here at *Electronics Australia* to help you in this latter area. Although Scientific-Atlanta has advised us that they cannot continue providing the articles on HFC Networks and Broadband Comms, which appeared in the November and December issues, we're actively searching for as much similar material as we can from other sources, to cover all facets of this important technology. So stay tuned...

Before closing I would like to thank the many people who have expressed sympathy at the passing of Neville Williams. These messages are much appreciated, and have been passed on to his family.

**Jim Rowe**

# Moffat's Madhouse...

by TOM MOFFAT



## *The Browser War: a Dispatch from the Trenches...*

If you're on the Internet, you'll know all about World Wide Web browsers by now. They're those software packages that let you display text and pictures from anywhere in the world, by simply clicking your way around with a mouse button. After a while you forget all about the software and just let the Web work its magic.

But in the background, forces are at work to try to pull you, the innocent Internet user, apart at the seams. Two fiercely competing camps want your loyalty: In the red corner, Seattle software behemoth Microsoft. And in the right corner, that bright new upstart kid from California, Netscape. Whoever wins this 'battle of battles' rules the on-line world — or so the story goes...

Netscape is credited with coming up with the idea of 'browsing' the World Wide Web in the first place. Prior to the emergence of the Web, Internet users actually had to type arcane commands (any typed commands are referred to as 'arcane' these days...), in order to make the Internet do anything. Anyone out there remember the good old days? The Unix operating system?

When you wanted to visit someone else's computer, you didn't just click on it on a pretty screen. Instead you used 'TELNET' to log yourself onto the remote computer as a guest user. Then you used arcane commands to do things like search other computers for interesting software. These search computers were known as 'ARCHIE' (probably based on the word 'archive') and they contained pointers to software treasures probably unimaginable today. You could get word processors, and spreadsheets, and database programs, and GAMES! Oh boy, some of those games, the ones running under MS-DOS, were just out of this world.

ARCHIE let you search for a program by typing in something like 'prog invaders' and then it would deliver a list of just about every computer in the world where there were such programs which

could be downloaded. Once you found your target, you then used another program called FTP (File Transfer Protocol) to suck the desired file into your very own computer. An arcane command such as 'get invaders.zip' did the trick.

Actually few people had computers capable of doing this all in one swoop. Internet accounts in the pre-World Wide Web days were known as 'shell accounts' — the main work was done by a central computer; all the user had was a simple terminal program to access it. So 'getting' something only got it as far as a disk area in the central computer, and it was then necessary to use another file transfer technique such as Zmodem to copy it from the central computer into your own machine.

This technology wasn't all that bad. It was very efficient and used a minimum of computer resources. So it was fast, and easy. TELNET and FTP are not dead yet, by all means. They still thrive in the background on the Internet, a kind of an underground community totally separate from the World Wide Web, even though both share the same communications links. The main ARCHIE server in Australia is known as `archie.au`; it can be accessed by 'TELNET `archie.au`'.

A wonderful FTP site lives on the same server; you can get at this one via 'FTP `archie.au`'. Good ol' ARCHIE is pretty much the same as it was back in the earliest days of the Internet in Australia. The file areas still contain some lovely software, but much of it is stuff that was the latest and best during the heyday of Unix and shell accounts. It's getting dated now, in these days of Windows and mega-programs, but much of it out-performs similar modern programs. Particularly things like Space Invaders, in its MS-DOS form. (You don't have MS-DOS with Windows 95? Rubbish! Consult Moffat's Madhouse, November 1996.)

Shell accounts are pretty hard to come by nowadays, at least here in my part of

the USA, but you can still do your thing with TELNET and FTP. And now, with modern PPP accounts, your computer is actually connected to the Internet, instead of just a shell. So when you 'get' a file via FTP, it comes right onto your hard drive in one slurp.

My own computer has a whole line-up of Internet applications, each accessible by clicking an icon. The most popular program for doing FTP is called `WS_FTP`. With this little gem you can download a program by simply clicking on its name in a list. But if you watch the command line at the bottom of the screen, you'll see that `WS_FTP` is actually sending 'get' to the remote computer. The original arcane commands are just hidden from you, as if you're not strong enough to stomach them nowadays.

After lots of searching, I've finally found a really nice TELNET application called `NetTerm`. This program can connect with two types of remote computers — those on the Internet, and other bulletin board type computers that you reach via a modem phone call. The computer names are displayed on a list, and when you click on a name the program makes the Internet connection, or dials the phone number, as appropriate.

Most TELNET use nowadays involves things like accessing a public library's on-line card catalog, or joining one of those enormous chat forums. In my work for an Internet Service Provider, I use TELNET to work on things like terminal servers and routers and net servers from the comfort of my own living room, sitting in front of the heater with a laptop computer.

### Back to browsers

But back to browsers. We, the users, see them as tools to bring nice things to the screens of our computers with the click of a mouse. Most of this takes place via HTTP or HyperText Transfer Protocol, but browsers are also quite happy using things like FTP and other 'getting' techniques such as Gopher

(go-for). You just don't see this happening, unless you keep an eye on the 'location' display on your browser screen. Then you might see 'ftp' pop up instead of 'http' when you are downloading your latest version of Netscape.

So the browser has evolved into a kind of 'mission control', for everything your computer might do over the Internet. But the browser is not on its own; there must be another piece of software called a TCP/IP stack, which handles the actual networking protocol of the Internet. The TCP/IP stack is included in a 'dialler', which is the software utility that places the phone call to your Internet Service Provider. It is important to know about the dialler, because it is one of the main battlegrounds in the browser war.

In Windows 95 the dialler is built in; it's known as the Dial-Up Adapter or Dial-Up Networking. Windows 3.1 doesn't have its own dialler, so the user must supply one himself. Programs such as Netscape Navigator in its Personal Edition supply a dialler for Windows 3.1 use. Probably the most popular external dialler worldwide is Trumpet Winsock, produced in Hobart.

For some reason which I fail to fully understand, diallers are sometimes arranged so that a client program using it can disable some of its functionality and take control for itself. This means that only one Internet application program can use the dialler. For people like me who have a whole suite of Internet applications — NetTerm, WS\_FTP, Netscape Navigator, Eudora e-mail program etc. — this means the dialler is practically useless.

Browser manufacturers quickly learned that if they wrote their software to take absolute control of the dialler, it would lock out other BROWSERS. So if you let Netscape install itself in the normal way, it very quickly snaffles the dialler, blocks out important network information from it, and takes control itself. This means that if someone should suddenly get the urge to download the latest version of Microsoft Internet Explorer and try it out, they'd find the Windows 95 dialler very uncooperative.

Conversely, Microsoft Internet Explorer will take control of the dialler, given half a chance, which prevents Netscape working properly in that computer. What's more, Microsoft proudly ballyhoos its nice 'un-install feature', which cleanly removes unwanted programs from Windows 95. But for un-install to work, each new incoming program must supply information needed for its later removal. Many programs do this, Netscape Navigator among them.

But Microsoft Internet Explorer, that flagship browser from Windows 95's own manufacturer, does *not* supply un-install information. And experience has shown that once Microsoft Internet Explorer is installed in Windows 95, the only way to get rid of it, and replace it with Netscape, is to totally re-install Windows 95. Is this dirty pool, or is this dirty pool?

We here at OlympusNet technical support have worked out a foolproof way to install the Windows 95 dialler so it works totally on its own, without any input from Netscape or Microsoft. These programs can of course use the dialler, but they don't own it. And all the other Internet programs can use the dialler too. Now isn't that much more civilized?

Lately we've seen other shenanigans that make one wonder if companies like Netscape are in cahoots with the computer manufacturers. For many months we had been recommending that new OlympusNet users purchase Netscape Navigator Personal Edition Version 2 for their Internet software. This was a very sturdy package, with versions for both Windows 3.1 and Windows 95 computers. It worked just great, when installed to our special instructions, which prevented Netscape from stealing the dialler.

Then one day, back about last October, Netscape released Netscape Navigator Version 3. We immediately ran out and bought a copy of the Personal Edition and installed it in my Toshiba 486SX33 notebook computer running Windows 3.1. Guess what! It didn't work. Or barely worked. Version 3 had expanded, bloated, exploded — it was so big that it didn't run any more, it *oozed*.

The problem is, very many of our OlympusNet users are running older computers — slower 486's, with perhaps eight megabytes of memory. Some are still running 386 microprocessors. This is fine, their computers are doing what they want from them, and now they just want to get on the Internet. Netscape Version 2 ran great on these computers; so we thought we'd just keep on recommending Version 2 and everything would be rosy.

But Netscape thought differently. With Version 3 the current version, Version 2 was no longer being sold. So we — OlympusNet — e-mailed Netscape, phoned Netscape, pleaded to speak with the big guy Jim Barksdale himself. PLEASE give us back Version 2!

But the word back from Netscape was: "Your Users Will Just Have To Buy New Computers". So there.

Our response was: 'Goodbye Netscape'.

Surely there must be another way.

Microsoft at least saw there were still people out there with Windows 3.1 and older, smaller computers, so they released a special version of Microsoft Internet Explorers just for them. But it was still very big, so we kept looking.

And then one day someone on an Internet newsgroup said, "Have you ever thought of Opera?"

No, we had never thought of Opera — we had never even HEARD of Opera. It turns out that Opera is a WWW browser made by a small company in Norway. Opera works quite happily with four megs of memory, in a 386 computer, and it runs circles around Netscape, even Version 2. Opera does all the usual FTP and newsgroups, but its e-mail is limited. It can only send e-mail, not receive. But that's no problem because most of our users prefer to use the Eudora e-mail program, anyway.

Opera, as it is downloaded from Norway (<http://opera.nta.no>), is around 900KB long, as opposed to three or four megabytes for the slimmest Netscape or Internet Explorer. This means we can distribute Opera on a single floppy disk, which we are negotiating to do as I write.

So here, at long last, is a way to rebel against the domination of big guys like Netscape and Microsoft. Buy new computers indeed! Are they cutting their own throats, trying to dictate to their customers in this way? Opera, and ISP's who understand the needs of their users, may give them the big fright they deserve. Maybe it IS over when the fat lady sings! ♦

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# ICOM'S NEW IC-R8500 RECEIVER

The latest addition to Icom's range of communications receivers is the IC-R8500, which covers a very wide frequency range: from 100kHz to 1999MHz. It also provides a broad selection of reception modes, IF shift and tuneable audio peaking filter controls, 1000 memory channels, flexible scanning functions and built in RS-232C and CI-V interfaces for monitoring and controlling the receiver's operation from a PC.

by JIM ROWE

Traditionally, communications receivers have fallen into two general categories: 'HF' receivers covering the spectrum below 30MHz, and 'VHF/UHF' receivers covering above 30MHz. This is because the requirements for optimal reception in these two broad segments of the spectrum are in many ways rather different, and for a long while it was difficult to build the functions and facilities needed for both into a single receiver. In fact when the first 'all in one' receivers did begin to appear, they tended to be complex and very expensive — with a front panel resembling the proverbial '747 cockpit'.

Icom's new IC-R8500 manages to fit just about all of the facilities that most people are likely to need for serious reception on both the HF and VHF/UHF bands, into a package no larger than a modern HF communications receiver. And while its front panel inevitably has a fairly impressive array of controls, at the same time the receiver is not particularly intimidating or hard to drive. In fact it's very similar in overall operating convenience to HF-only receivers like Icom's classic IC-R71A.

The specification of the IC-R8500 is impressive. It tunes from 100kHz right up to 1999.99999MHz, with specifications guaranteed between 100kHz and 1000MHz and also from 1240 - 1300MHz. Over most of this range it also provides just about all of the reception modes that most people are likely to need for general purpose work: AM (wide, normal and narrow band), SSB (USB, LSB), CW (normal, with optional narrow), FM (normal or narrow band) and WFM (above 30MHz).

Over most of the frequency range, and in the majority of reception modes, it operates as a triple conversion superhet with a third IF of 455kHz and a second IF of 10.7MHz. The main exception to this

is in WFM (wideband FM) mode, where it naturally drops the final conversion down to 455kHz and below 1024.999MHz becomes a double conversion set. (Above 1025MHz it uses built in front-end converters, so it is effectively remains a triple conversion set for WFM and assumes a quadruple conversion configuration for the other modes.)

For the HF part of the spectrum the first IF is 48.8MHz, with 778.7MHz used for the range from 30 - 499.9999MHz and 266.7MHz for the range from 500 - 1024.99999MHz. As a result of this choice of IFs, and the set's filtering and shielding, it achieves a rated spurious and image rejection ratio of 60dB over the HF range and 50dB from 30 - 1000MHz and 1240 - 1300MHz.

Rated sensitivity of the receiver for SSB/CW reception varies from 0.2uV between 2MHz and 30MHz, to 0.32uV between 30MHz and 1300MHz and 2.0uV between 500kHz and 1.8MHz; for AM, it varies between 13.0uV for the 500kHz - 1.8MHz band down to 2.5uV for all frequencies between 2MHz and 1300MHz; for AM narrow, it's 2.5uV between 1.8MHz and 2.0MHz, and 2.0uV at all frequencies between 2MHz and 1300MHz; for AM wide, it's 3.2uV for all frequencies between 30MHz and 1300MHz; for FM it's 0.5uV for all frequencies between 28MHz and 1300MHz; and for WFM, it's 1.4uV from 30MHz to 1000MHz and 2.0uV from 1240MHz to 1300MHz. These figures are on the basis of 10dB S/N ratio for SSB, CW and AM, and 12dB SINAD for FM and WFM.

The selectivity for CW, SSB and AM-narrow is rated at 'more than 2.2kHz' at -6dB, while that for AM and FM-narrow is 'more than 5.5kHz' at -6dB. The equivalent figure for FM and AM-wide is 'more than 12kHz', while that for WFM is 'more than 150kHz'. With the optional CW-nar-

row filter fitted, the rated selectivity is 'more than 500Hz' at the -6dB point.

Rated frequency stability of the receiver is  $\pm 100$ Hz below 30MHz and  $\pm 3$ ppm above 30MHz, with the standard crystal master oscillator supplied. However as with earlier models a higher stability TCXO unit is available as an option, providing a stability of  $\pm 20$ Hz below 30MHz and  $\pm 0.6$ ppm above 30MHz.

The IC-R8500 is of course fully synthesised, using both DDS and PLL circuitry, and offers a wide range of tuning steps: 10, 50 or 100Hz; 1, 2.5, 5, 9, 10, 20, 25 or 100kHz; 1MHz; or programmable between 500Hz and 199.5kHz, in 500Hz increments. Manual tuning is normally via the usual rotary knob, but you can of course jump to a new frequency by keying it in with the numeric keypad.

There are no less than 1000 memories built into the IC-R8500 for storing frequency, mode, bandwidth and tuning step data relating to signals of interest. The memories are divided into 20 banks of 40 'channels', plus a bank of 100 for 'auto memory write' when scanning, and another area of 100 for storing scanning 'skip' frequencies. Each channel and bank can be given an alphanumeric name, with up to eight characters available for the channel names and five for the bank names.

In addition, there's a further 20 channels to store 10 pairs of 'start' and 'finish' frequencies for programmed scan, plus one further channel for 'priority' scan.

The scanning facilities are themselves quite impressive. There's memory, priority and programmed scanning for 'basic' scanning, plus select, skip, autowrite and mode select scanning for more specialised purposes. Thanks to DDS technology the IC-R8500 can scan very rapidly (up to 40 channels/sec in memory and programmed scans), but the delay or 'pause' time can be adjust-



ed between three and 18 seconds. You can also set the receiver to skip unmodulated carriers, and only pause on those with modulation.

Needless to say the receiver has a fully adjustable squelch control, which is active in all reception modes. The squelch level is linked to the S meter, making it easy to set the control so that you only receive signals stronger than a desired level.

How about facilities for reception of signals on the crowded and noisy HF bands? Well, the IC-R8500 has a noise blanker, two fixed RF attenuators (10dB and 20dB) which can be cascaded, and selectable AGC fast/slow characteristics. In CW and SSB modes it also offers an IF shift control, to vary the centre frequency of the IF filter over a small range — so that you can optimise the position of the filter skirts to favour the wanted signal, while attenuating an interfering signal close by.

But that's not all. There's also a tuneable audio peaking filter, which lets you again favour your wanted signal while reducing the level of neighbouring interference. This is a very nice feature, normally only found on much more expensive receivers, which can really help when you're trying to dig weak signals out of an HF band that is crowded with jostling high-powered broadcasters.

Incidentally despite its state of the art circuitry, the IC-R8500 has a conventional moving-coil analog S meter — much easier to read, for many people, than an LED or LCD bar-graph display.

Other features include a 'sleep timer', with four selectable settings (30, 60, 90 and 120 minutes); a headphone output jack; a separate audio line output jack, for recording; and a recording control jack, so that the IC-R8500 can control the tape recorder's operation for continuous monitoring work.

As you might expect, separate antenna input connectors are provided at the rear for HF and VHF/UHF reception. This is logical, as different antennas will normally be used. For HF reception it provides an SO-239 connector for a 50Ω antenna and an RCA/Cinch connector for a 500Ω antenna; for VHF/UHF reception there's a type N connector for a 50Ω antenna.

Also on the rear panel is an external speaker jack (8Ω); a 10.7MHz IF output connector (used to drive an outboard TV reception/FM stereo module, which is an option); an AGC output connector, for controlling the same module (and also providing raw demodulated audio in FM mode, to drive an RTTY or packet radio modem); a connector for the Icom CI-V serial control interface, for PC control/monitoring; and also a DB-25 connector, providing an alternative standard RS-232C interface for the same purpose.

Incidentally the basic IC-R8500 receiver operates from 13.8V DC, and can thus operate directly from a car battery. However for convenient mains operation it also comes complete with a separate 'in cord' power supply, whose output cable can be

plugged into a matching coaxial socket on the rear panel. There's also a polarised DC input socket which mates with a DC input cable (supplied). The receiver draws 1.8A at 13.8V in standby, and 2A when producing the maximum audio output of 2W.

## How we found it

We were able to try out a sample IC-R8500 receiver for a couple of weeks, using a combination of two antennas: a balanced 'inverted V' with arms about 12m long, for HF, and an Icom AH-7000 wideband discone for VHF and UHF. We also checked out some of its primary performance characteristics using our instruments.

We found it a delightful receiver to use, with an excellent combination of features, performance and operating convenience. The frequency coverage is of course as wide as almost anyone could wish, for the vast majority of reception needs, but this coupled with facilities like variable selectivity, noise blanking, IF shift and that tuneable audio peaking filter — so the receiver's wide bandwidth hasn't involved a sacrifice in its ability to 'deliver the goods' on the crowded HF bands.

When we tested it with the instruments, we couldn't quite match the manufacturer's figures for AM and FM sensitivity at all frequencies. However the figures for most of the range were close enough to verify that

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# THE RAMP 8 SPEAKER SYSTEM

For this month's review Louis Challis has been evaluating a loudspeaker system from a new Australian manufacturer: Ramp Audio, of Pymble in NSW. The new Ramp 8 system is an innovative design with a number of interesting and attractive attributes — along with one or two that are less so.

Back in May last year, we received a letter from Patrick Rougon, of local loudspeaker manufacturer Ramp Audio, proposing that we should test a pair of his newly developed 'Ramp 8' loudspeakers. The letter extolled the virtues of his company's product, claiming multiple advances in design, construction and performance. The review was slotted into our schedule, and in due course a pair of 'Ramp 8' speakers were delivered directly to our office.

It was at that stage that I re-examined the claimed attributes of the new speakers, and differences between them and other speak-

ers with which they were loosely being compared. Mr Rougon's letter referred to a Mr Alan March as the Ramp 8 system designer. Mr March apparently has 40 years of experience in designing and developing innovative loudspeaker systems. Interestingly enough, though, the letter also claimed that most of the multiple innovative features had never previously been integrated into a loudspeaker design.

That seemed a rather bold statement, considering that the next page of the letter referred to a number of illustrious pioneers whose work was then given due

credit for the design concepts which have been adopted in the design of the RAMP 8 loudspeakers.

The designers whose work and papers are cited, include H.F. Olsen and his papers on 'Direct Radiator Loudspeaker Enclosures', 1951 and 1969, H.D. Hardwood and his paper on 'Speakers in Corners', 1970, and R.F. Allison's papers on 'The Influence of Room Boundaries On Loudspeaker Power Output', 1974.

An examination of one of the speakers confirmed that Mr March has indeed adopted a distinctly 'different' configuration. My attention immediately focused on the shape of the cabinets and the position of the three drivers (the mid-range and tweeter at the front, and the woofer at the rear).

Whilst that configuration is not unique, there are some obvious differences between the implementation of this configuration and the majority of other three-way speaker systems currently being marketed in Australia.

The low frequency driver has been deliberately positioned as close as possible to the floor level at the rear of the cabinet. Its conventional tubular bass reflex venting port is positioned 600mm above the floor. Patrick's letter claimed that this was selected to achieve a  $1-\pi$  steradian radiation characteristic for the enclosure at low frequencies.

The low frequency driver is located in a position which would be extremely vulnerable to premature damage, if not appropriately protected by a strong and sensible black painted steel grille. The grille has been installed with sufficient clearance from the driver's diaphragm to ensure that you don't damage the diaphragm with your fingers, nor produce unwanted mechanical contact under drive conditions, which result in maximum possible diaphragm excursion.

I was intrigued by the adoption of the name 'ramp' for both the company and the speaker system. This appears to be the result of Mr March having adopted a sloping or 'ramped' enclosure in the cabinet space, behind the mid-frequency and high-frequency driver at the top of the cabinet. The reason for adopting a 'RAMP' structure is quite sensible, and would most probably achieve useful reduction of standing waves within the cabinet, subject to providing appropriate acoustical infill to further detune those unwanted cabinet resonances.



## Solid cabinets

The cabinets are solidly made. I discovered that they derive significant structural enhancement, anti-resonant stiffening, and appropriate dampening to minimise unwanted resonances, as a result of their incorporation of a series of well conceived internal bracing elements. The largest and most critical of those bracing elements is a thick angled brace centrally located between the two major side panels.

The ramp panel at the upper end of the enclosure also provides useful bracing for the top of the cabinet, whilst an additional bracing block has been sensibly positioned immediately above the low frequency driver's cut-out, on the cabinet's inner rear panel face.

A pair of colour-coded Universal speaker terminals are sensibly located approximately 450mm above the floor on the speaker's black painted rear panel. The crossover network is located immediately adjacent to those terminals inside the cabinet.

Regrettably, as I subsequently discovered, the RAMP 8 system has not been provided with any form of speaker protection which would protect the drivers or crossover in the event of excessive drive or inadvertent abuse.

The designers have gone to considerable trouble to chamfer the front vertical edges of the cabinet. The mid-range driver and tweeter are mounted on a panel which extends beyond the line of the front face of the cabinet. This approach has been supplemented by the provision of a relatively neat (but rather bulky) cloth covered framed speaker grille, which clips over the top of the extended speaker baffle.

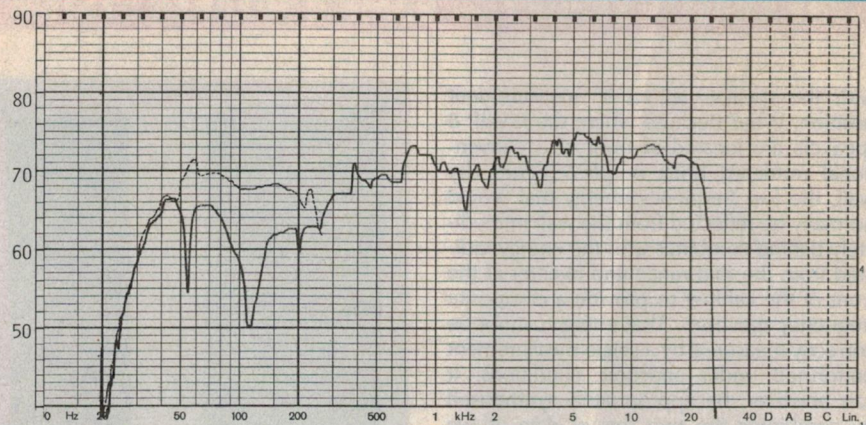
This results in minimal adverse impact of the speaker grille's framing on the tweeter's peripheral sound radiation components, ensuring that the polar plots are smooth and relatively free from any adverse 'comb filter' reflection problems that might otherwise be generated.

The crossover's high pass cutoff frequency for the section serving the low frequency driver was nominally designed to occur at 150Hz. As my subsequent measurements confirmed, the choice of components for the crossover, or their imprecision has actually resulted in a crossover frequency which appears to be somewhat higher, and closer to 250Hz, rather than 150Hz. This results in the mid-range driver operating over a narrower frequency bandwidth than might have otherwise been intended.

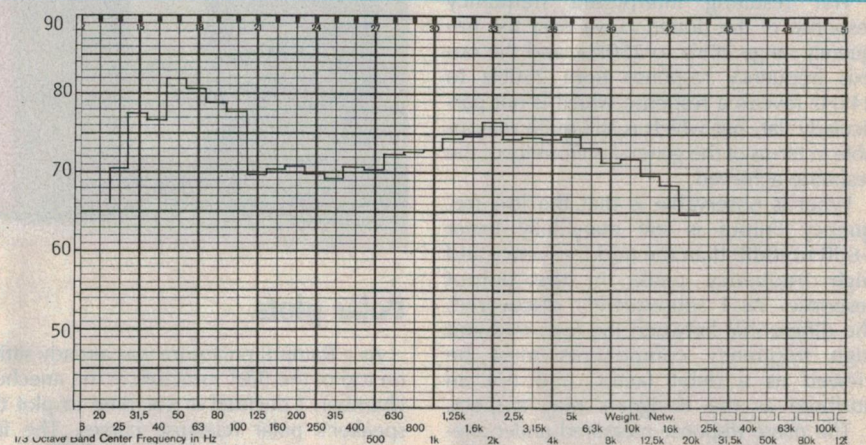
## Objective testing

During the initial set of objective tests on axis frequency response measurements conducted in our anechoic chamber, we observed two rather deep notches in the frequency response curve. The first notch was at 110Hz. This was primarily due to a phase difference in path lengths between the low frequency driver and its port on the rear face of the cabinet, and the diffracted components of sound energy passing around the two sides of the cabinet to

Frequency response - 1m on tweeter axis & 1m at 180deg off axis



1/3 octave band pink noise room response



reach the monitoring microphone. That notch was not a source for complaint, as it was effectively nullified by rotating the speaker through 180° to measure the sound radiating from the rear of the cabinet, under anechoic test conditions.

Whilst the low frequency notch was not a cause for concern, the second notch which was observed at 3.3kHz most certainly was. We attributed this to an inadvertent switching of wires whilst interconnecting the mid-frequency driver to the crossover.

We were so confident that we were right, that we decided to temporarily terminate our testing whilst the designers checked out their wiring configuration to confirm whether we were right or wrong. This was promptly done, and they confirmed that they had inadvertently reversed the speaker connections. The intrusive notch disappeared thereafter. We then re-tested the on-axis frequency response at 0° and 180°.

We then combined the results of the lower frequency section of the data recorded with the cabinet rotated through 180° as a dotted line, superimposed on top of the on-axis frequency response curve, recorded

**A novel aspect of the Ramp 8 system design is the rear mounting of the woofer, behind a grille near the bottom. The reflex port is visible somewhat higher, also on the rear.**



## THE CHALLIS REPORT — RAMP 8 SPEAKER SYSTEM

with the speaker set to 0° measurement position. Why? Because where the RAMP 8 speakers are located in front of a conventional rendered brick or plasterboard dry wall, the low frequency energy that would normally be reflected from the wall immediately behind combines with the energy radiated from the mid-range and tweeter at the front of the cabinet to provide a composite frequency spectrum. That energy cannot be correctly measured by a single measurement performed under anechoic conditions. It can however, be appropriately synthesised by combining the two sets of data as we have done on the curve.

The resulting interpreted frequency response of the dotted curve over the frequency range 20Hz to 250Hz, and the on-axis frequency response from 250Hz to 24kHz reveals a response which is not particularly flat, but which is still quite reasonable in terms of the general uniformity of the response achieved.

What is observable is that the low frequency output is still marginally lower (-6dB to -8dB) than the mid-frequency and high frequency peaks in the output response. As I subsequently discovered, the differential between the low, mid and high frequency components must be viewed as a debit factor, and not an attribute as the designers may suspect.

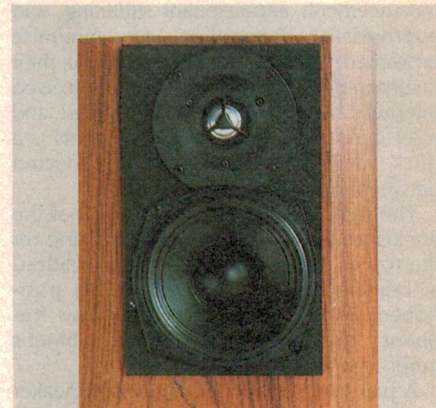
The phase response measured under anechoic conditions is reasonably smooth. The only obvious defect in the phase response occurs at 3.3kHz, in the vicinity in the crossover between the mid-range and tweeter. This characteristic shows up in both the wrapped and unwrapped phase responses. Notwithstanding the defect, the overall phase response is reasonably smooth and worthy of commendation rather than criticism.



### Polar plots

As a Ramp 8 enclosure was already sitting on top of the B&K turntable in the anechoic chamber, I decided it was time to plot the speaker's polar response curves. The frequencies selected were the standard ones of 1kHz, 3.15kHz, 6.3kHz and 10kHz. With only two plots per polar graph, in order to ensure that there was minimal impact between the first and second graph on each sheet, the sensitivity at 0° was offset by -10dB for one graph, relative to the second.

If you examine the polar plot for 3.15kHz, which was set 10dB lower than



*Two further views of the Ramp 8 system, with the front and rear of the enclosures contrasted at left, and a close-up of the tweeter and midrange drivers shown above. As you can see, these drivers are mounted right at the top front. At lower left is the cumulative spectral decay characteristic.*

the 1kHz plot, you will observe that the response between 30° and 90°, and between 270° and 330°, is 10dB higher than it is directly on-axis at 0°. As a consequence, if you sit in an off-axis position, you will observe that the speakers display considerable mid-range presence, and an overall frequency response which varies considerably from that which we measured on-axis in our anechoic chamber.

A change in sensitivity of that magnitude is significant as it is both measurable, and not so surprisingly, readily audible.

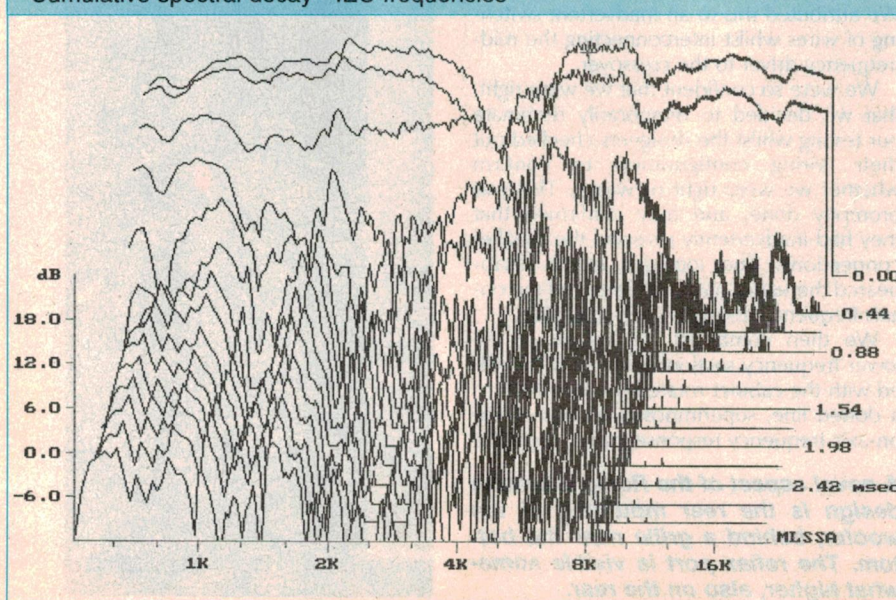
The measured polar plot at 6.3kHz and 10kHz are more uniform and reasonably consistent. The tweeter's directivity and output uniformity over the critical +/-30° arc, relative to the main axis, is reasonably smooth and uniform. The output droops by 6dB at +/-40° from the tweeter's main axis.

I was intrigued by the shape of the polar plot at 3.15kHz, and believe that the designers would do well to explore the underlying reasons for this unusual phenomenon.

The next step in the investigation involved measuring the Ramp 8's decay response spectra. The decay response spectra revealed traces of significant resonances around 800Hz, with other significant resonances in the 3 - 6.5kHz region. As I subsequently discovered, those resonances are audible as well as being measurable.

Although Ramp Audio have cited the Vifa D25AG tweeter as having outstanding clarity and accuracy, it may be that they were unaware of its other 'attributes'. Those attributes would not show up under conventional static testing, and even decay response spectra recorded under normal semi-reverberant room conditions would not necessarily identify the presence of that specific idiosyncrasy.

Cumulative spectral decay - IEC frequencies



On closer examination of the decay response spectra, you will observe that there are a series of slowly decaying resonant characteristics which extend from just over 3kHz to beyond 8kHz. Whilst the conventional static frequency response characteristics of the Vifa D25AG tweeter may look good, I am less than impressed with its dynamic characteristics.

My next assessment involved examining the Ramp 8's input impedance curve. As you will observe, there is a significant peak of nearly 22 ohms at 18Hz, and another peak of just over 14Ω at 48Hz. The lowest impedance occurs at 70Hz, which is just below 4Ω. Thereafter, the impedance curve across the rest of the frequency curve is remarkably smooth, ranging between 4Ω and 8.5Ω.

When assessed on the basis of the IEC's impedance rating procedure, the Ramp 8 would be classified as having a nominal 4Ω loudspeaker input impedance.

## Distortion performance

When it came to measuring the Ramp 8's steady-state harmonic distortion characteristics, I was a trifle bemused as to what I might find, in view of what I had already seen. The harmonic distortion characteristics at 100Hz measured at an output level of 90dB at 1m gave a THD of 0.17%, which is quite acceptable. By the time the level is increased to 96dB, the components of harmonic distortion rise rapidly, when compared to the fundamental.

I tried increasing the level to a higher level than 96dB. By the time the level reached 98dB, I had reached what appeared to be a saturation or compression limit. Any increases in the input level to the amplifier resulted in no significant increase in output level from the speaker. All that was observable was an increase in harmonic distortion, with minuscule increases in the fundamental output.

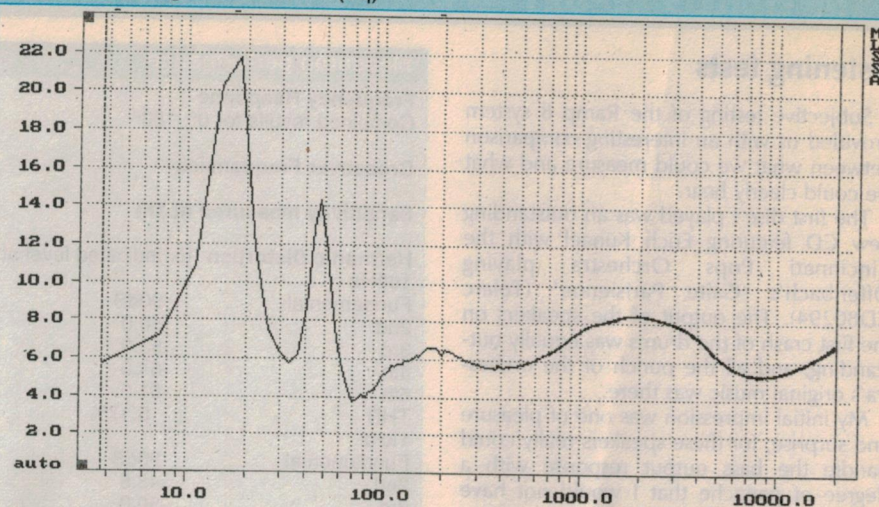
With an alternative test frequency of 1kHz, the level of output distortion was quite acceptable at 100dB, and was fully useable up to an output signal level of 106dB.

At 6.3kHz, by the time the signal reached 96dB at 1m, the distortion was starting to climb fairly rapidly. In view of the lack of passive speaker protection, and to avoid the risk of embarrassing damage to the speaker drivers, we terminated the distortion testing at this point.

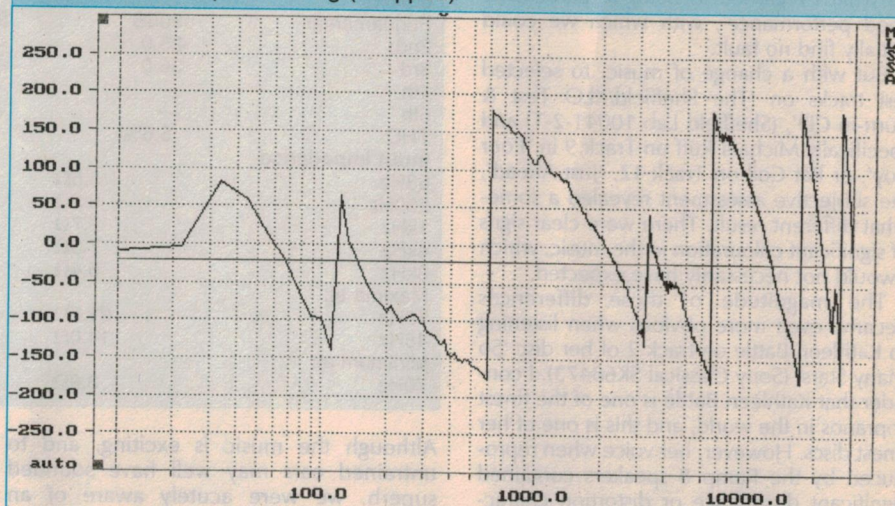
Viewed on the basis of the overall results of the objective testing program, the Ramp 8 loudspeaker performed reasonably well in all areas other than in terms of the harmonic distortion characteristics at high output levels, and its decay response spectra measured under anechoic test conditions.

The last objective test was the assessment of the speaker's room response in my listening room, using pink noise from track 18 on 'The Sheffield/Coustic Test and Demonstration Disc' (Sheffield Lab 10040-2-T). The test revealed that over the frequency region 25Hz to 100Hz, the speaker's low frequency output is at least 6dB higher than the rest of the spectrum. The rest of the spectrum has a moderate level of increased 'presence' as a result of a gentle 6dB rise in the 1kHz to 4kHz region.

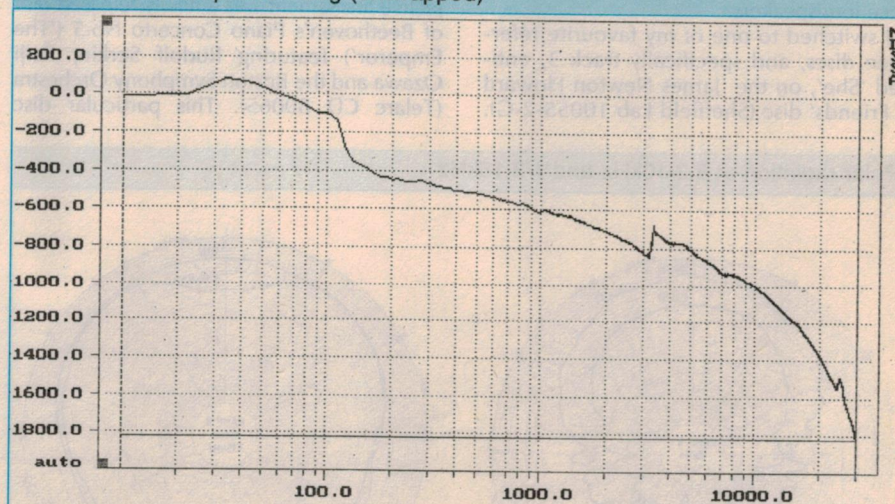
Impedance magnitude - ohms (eq)



Transfer function phase - deg (wrapped)



Transfer function phase - deg (unwrapped)



Above are three further measured response plots for the Ramp, with the top curve showing the electrical impedance vs frequency. The other two show the wrapped and unwrapped phase response.

# THE CHALLIS REPORT — RAMP 8 SPEAKER SYSTEM

## Listening tests

Subjective testing of the Ramp 8 system provided us with an interesting comparison between what we could measure and what we could clearly hear.

The first disc I played was an outstanding new CD featuring Erich Kunael with the Cincinnati Pops Orchestra playing Offenbach's 'Gaité Parisienne' (Telarc CD80294). The output of the speakers on the first crash of the drums was equally outstanding, and all the punch of the orchestra's original music was there.

My initial impression was one of pleasure and surprise, for these speakers really could handle the bass output response with a degree of panache that I would not have expected. On rock, hard rock, jive, reggae and even some choral music, where there are multi-instruments, the Ramp 8's provided what I regarded as being a 'particularly good performance', with which we could initially find no fault.

But with a change of music, to selected test tracks on 'The Sheffield/XLO Test & Burn-in CD', (Sheffield Lab 10041-2-T) and specifically Michael Ruff on Track 9 in 'Poor Boy', or Pat Coil on Track 12, 'Just Ahead', the subjective assessment revealed a somewhat different result. There were clear signs of significant colouration in the music, which I would not necessarily have expected.

The magnitude of those differences became even more obvious when listening to Kathleen Battle on track 2 of her disc 'So Many Stars' (Sony Classical SK68473). I consider that Kathleen Battle is one of the finest sopranos in the world, and this is one of her finest discs. However, her voice when reproduced by the Ramp 8 speakers contained significant dissonance or distortion characteristics. Those characteristics were not audible when conducting an 'A-B/A-B' comparative assessment with my B&W 801M reference loudspeakers.

I switched to one of my favourite reference discs, and specifically track 3, entitled 'She', on the 'James Newton Howard & Friends' disc (Sheffield Lab 10055-2-G).

## Measured performance

<b>Frequency Response</b>		35Hz to 22kHz +/-6dB	
Combined results for 0°, 180°			
<b>Crossover Frequencies</b>		Nominally 150Hz and 2kHz	
<b>Sensitivity measured at 1m</b>		<b>87dB</b> (for 1W into measured 7Ω impedance)	
<b>Harmonic Distortion</b> (for indicated level at 1m)			
<b>100Hz</b>			
Fundamental	90dB	96dB	98dB
2nd	-50.0	-34	(Compression
3rd	-52.0	-54	limit reached)
4th	-64.0	-61	—
5th	-61.0	-58	—
THD	0.17%	4.0%	—
<b>1kHz</b>			
Fundamental	90dB	96dB	100dB
2nd	-43.5	-42.0	-38.0
3rd	-50.0	-49.0	-48.0
4th	-61.0	-61.0	-59.0
5th	-52.0	-53.0	-58.0
THD	0.62%	0.81%	1.8%
<b>6.3kHz</b>			
Fundamental	90dB	96dB	(High levels
2nd	-35.0	-34.0	not evaluated)
3rd	-36.0	-35.0	
4th	—	—	
5th	—	—	
THD	5.6%	7.1%	
<b>Input Impedance</b>			
63Hz	5.5Ω		
250Hz	6.2Ω		
1kHz	7.7Ω		
4kHz	7.3Ω		
8kHz	5.4Ω		
<b>Maxima at:</b>			
19Hz	21.8Ω		
48Hz	14.0Ω		
<b>Minimum at:</b>			
70Hz	3.9Ω		

Although the music is exciting, and to untrained ears may well have sounded superb, we were acutely aware of an unwanted harshness, which was obviously being generated by the tweeters.

The last disc which we used for our subjective assessment was a newly released disc of Beethoven's Piano Concerto No.5 ('The Emperor') featuring Rudolf Serkin, Seiji Ozawa and the Boston Symphony Orchestra (Telarc CD 80065). This particular disc

which I consider to be one of Serkin's best renditions, was recorded in 1981. Although the music is outstanding, the reproduction on the Ramp 8 loudspeakers was good, but by no means outstanding.

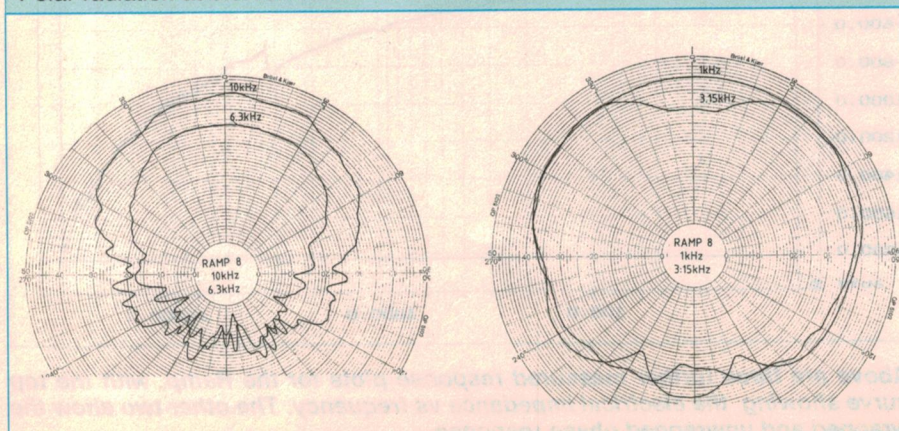
## Summary

The Ramp 8 loudspeakers do contain a number of highly successful innovative features. Many, although by no means all of the manufacturer's claims for the design are warranted. If only the system had a tweeter to match the other two drivers, and a small padding resistor incorporated in the woofer's crossover circuit, it could easily be in the top quartile of Australian manufactured loudspeakers.

Whilst I am in no hurry to commend these 'Mark 1' versions of the Ramp 8 loudspeaker system to you, I must acknowledge that if the designers follow them with a 'Mark 2' version along the lines suggested, I would expect these to provide superb performance.

The dimensions of the Ramp 8 enclosures are 920 x 227 x 360mm (H x W x D), and each enclosure has a weight of 21kg. The Ramp 8 system carries an RRP of \$2900 per pair. For further information contact Ramp Audio at 12 Orana Avenue, Pymble 2073; phone (02) 9144 1647. ♦

Polar radiation at 6.3/10kHz and 1/3.15kHz





## GOODBYE MISTER (WOOD FOR) CHIPS

For the last 13 years, Geoff Wood Electronics with its vast array of semiconductors has been a veritable 'magnet' for both professionals and enthusiasts looking for hard-to-find chips. But no more, sad to say. Geoff Wood himself retired in 1988, and now the firm's remaining stalwart Peter Moon has also decided to 'call it a day'...

Geoff Wood Electronics, one of the few remaining independent distributors, will finally close its doors on 24th January. The business was set up in 1983 by Peter Moon, as a cash sales outlet for his semiconductor distribution business, Semtech — together with Geoff Wood, best known as the driving force behind Radio Despatch Service.

Their first shop was in Rozelle, but later moved to Lane Cove. 'Wood for Chips' became their much promoted tag line...

Peter Moon has had a very long association with the semiconductor industry in Australia. After an apprenticeship as an electrician, he worked on the Snowy Mountain Scheme and at Maralinga. However it was an unexpected meeting with a snake under a house, when replacing some wiring, that pushed him into a major career change!

In 1968, he answered an advertisement placed by Jack Rutherford in the Sydney Morning Herald, to open a Sydney branch for Jack's family business — selling bits and pieces, including parts from the fledgling National Semiconductor.

Peter says he owes most of his success to Jack Rutherford's influence. "Many of today's leading players were trained by Jack", says Peter, "You can see his hallmark on companies like Veltec and University Paton."

Before his interview for the job with Jack,

Peter was fortunate to get hold of a couple of articles in the famous English journal *Wireless World* on the new technology of linear and digital integrated circuits. Needless to say he landed the job — at one of the most exciting times: the birth of a whole new industry.

Working on the National Semiconductor account he met Charlie Sporck, also Andy Groves of Intel and Bob Widlar, who invented the 702 — the first IC op-amp — for Fairchild.

Rutherford changed the name of his business in 1972 to concentrate full time on National Semiconductor, with Moon as his Sydney manager. Peter vividly recalls his first visit to Sydney University, and the huge crowd that greeted him when word got around that the man from National Semiconductor was visiting!

In 1980 the opportunity arose to take over one of National Semiconductor's distributors, Semtech. Before long a growing need for a cash sales outlet led to the opening of Geoff Wood Electronics, which has been one of the main local sources of small quantities of semiconductors. The vast array of small parts drawers, containing many thousands of semiconductors, almost became a trademark of the business.

Today the arrival of international operations like RadioSpares and Farnell, with their very broad catalogue ranges, has

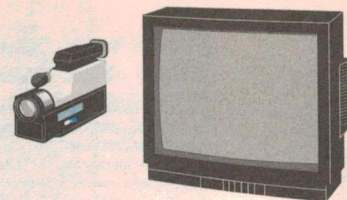
sounded the death knell for businesses like Geoff Wood Electronics. Increasing minimum order quantities made it harder to maintain a wide range of components ex-stock, and Moon watched as more and more of the well known names disappeared. The world-wide trend was towards 'fewer and bigger' — "companies like Avnet and Arrow, whose turnover is measured in billions of dollars, and who are definitely not Australian owned!"

Moon also laments the passing of the semiconductor industry in Australia, when the Whitlam Government wiped out tariffs and within three months National, Fairchild and STC were all forced to close their plants. The world's semiconductor industry was only eight or nine years old and just starting to take off. "If the tariffs had been reduced more slowly, who knows what might have been?" he says.

Born in Lane Cove and dreaming of having his own business as he drove past what later became his Lane Cove shop, on his way to apprentice training, Peter now dreams of travel and getting back to a slower pace of life.

"I certainly enjoyed the excitement of being a part of a rapidly growing industry. But as the pace gets faster and faster, I think it'll be a whole lot easier to just read about the progress in EA each month!". ♦

# What's New in VIDEO and AUDIO

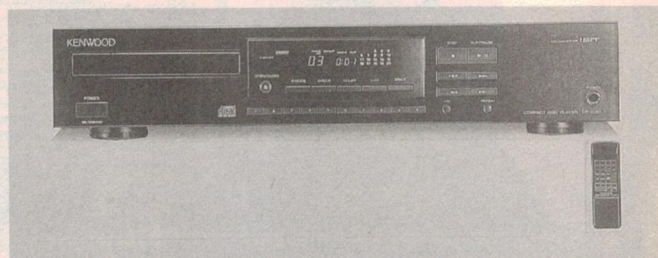


## New 'serious' CD player from Kenwood

Kenwood claims its new DP-2080 CD player provides 'serious' compact disc sound quality combined with versatile operating functions — at the right price. Very high sound quality is assured because the DP-2080 uses Kenwood's single-bit DAC with high level noise shaping and oversampling, plus its exclusive DPAC time alignment technology which makes sure the digital signal is stable for accurate processing.

CCRS and edit functions ensure easy recording from the DP-2080 to tape. Press a button and CCRS (Computer Controlled CD Recording System) automatically scans the CD, adjusting the tape deck for wide dynamic range before starting the recording. This ensures even the loudest passages will not saturate the tape to cause distortion.

Other features of the DP-2080 include a 20-track memory



and music calender, auto space function, an eight-times oversampling digital filter for improved resolution and 23-button infra red remote controller.

The Kenwood DP-2080 CD player is all covered by a 24-month warranty, has an RRP of \$299 and available at selected Kenwood audio dealers.

## Lowther drivers, kit enclosures available

British-made Lowther loudspeakers have been in production for over 50 years, and have long been popular among hifi enthusiasts in many countries. The drivers are hand made in limited quantities at Lowther Voigt Ltd., England.

Lowther drivers are of the full-range type, to avoid the need for crossover networks. They have extremely powerful magnets (Alnico or ceramic), ultra-light weight paper cones and a phase stabilising core. The diaphragm assem-

bly, main cone and aluminium or silver voice coil have compliances engineered throughout to provide a balanced response over the full audio spectrum: 40Hz to 20kHz.

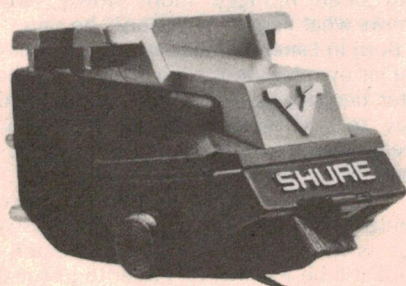
Each voice coil is specially designed for the gap flux of the unit in which it operates. Self resonance of all driver units is below 40Hz. The Lowther Stabiliser (patented) or phase plug provides air loading to the inner cone and prevents crosstalk within the cone. The contour between the phase plug and inner cone forms a short horn, for the emission of high-order harmonics and overtones.

Lowthers are high efficiency speakers (96-98dB/1W/1m). Some enclosures, such as the Mau Horn, are 100 - 102dB efficient. An amplifier output of 3W - 15W is adequate in listening rooms up to 9 x 6 x 2.4m.

The sole distributor of Lowther drive units for Australia and New Zealand is Australian Electric Valve Importers. For further information on either Lowther drivers or matching DIY enclosures, contact the company at Factory 2, 22 Michellian Court, Bayswater 3153; phone (041) 900 9115 or fax (03) 9720 8729.

## Shure's V15 returns

Introduced in 1964, Shure's V15 was virtually the standard by which all other traditional phono cartridges were judged. However Shure discontinued the V15 series in 1994, in reaction to the shrinking market for phonograph cartridges.



Now, however, in response to ongoing consumer demand and a revival of interest in vinyl recordings, the V15 has returned in a new and improved version: the V15VxMR. Shure says the model will fill the critical void that exists in today's market, for a true high performance phono cartridge which extends the playing life of irreplaceable vinyl LPs.

With its updated technology the V15VxMR provides a warmer, more musical sound than ever before, without compromising the extraordinary high frequency tracking capability of its predecessor. It requires only one gram of force applied to the diamond stylus tip to achieve optimal performance.

The V15VxMR features a beryllium tube stylus cantilever which achieves accurate high frequency signal track-

ing with low effective mass. This unique construction prevents the irreversible damage caused by high frequency mistracking. It also features a dynamic stabiliser which functions like a miniature shock absorber, to maintain a constant cartridge-to-record distance which ensures uniform tracking force.

The newly released Shure V15VxMR has already been selected by Sony Music in the US as the reference cartridge for their archival operation. It is distributed exclusively in Australia by Jands Electronics and retails for an RRP of \$525.00.

For further information circle 140 on the reader service card or contact Jands Electronics, 578 Princes Highway, St Peters 2044; phone (02) 9516 3622.

## Home theatre speakers from Sonique Audio

Sonique Audio, the South Australian manufacturer of high quality loudspeakers and Micrex hifi amplifiers, has released a new Sonique AV range of home theatre loudspeakers. The new range was developed not only for the Australian market, but also for international markets in Europe, Asia and America — where Sonique has a high reputation.

Included in the Sonique AV series are three models designed as main speakers, including the SAV-2 Small Bookshelf Monitor, the SAV-3 Full Range Compact loudspeakers and the SAV-4 Full range floor model. Others in the range include the SAV-1 Rear/Satellite loudspeakers, the SAV-C1 Dedicated Centre Channel and the high performance SAV-SUB1 Active Subwoofer.

All models can be purchased as individual components to enhance, improve and expand existing systems, or as complete Sonique AV matching sets.

The Sonique AV range is styled to blend into the home decor without being intrusive. All models are finished in a high quality textured black lacquer with matching shear grille cloth.



Available throughout Australia, Sonique AV products start at \$495 and provide a many options right through to the complete System 4 at \$4000.

For further information circle 141 on the reader service card or contact Sonique Audio 14 Kindale Court, Pooraka 5095; phone (08) 8262 7911 or fax (08) 826 21189.

## Video projector for multi media presentations

Mitsubishi Electric has introduced the VS-1281E, a new Auto-Scan video projector which accepts horizontal scan frequencies from 15 to 103kHz and vertical frequencies between 40 and 150Hz. A wide range of input sources can also be used on the VS-1281E, including VCRs (PAL, NTSC or SECAM), laserdisc players, high resolution PCs or workstations — making it very suitable for multimedia presentations.

The VS-1281E incorporates a newly developed 7" CRT (x3), with impregnated cathode and an electro-magnetic



focusing system. This feature provides a high level of brightness and improved cathode life. The Flexible Optical Coupling (FOC) lens allows the use of a wide range of screen sizes

from 70 to 300" (diagonal), whilst maintaining contrast performance.

Mitsubishi has also developed special integrated circuits to implement Full Digital Convergence Control, allowing faster and simpler picture adjustment.

The Easy Adjust function uses 25 points on a five by five grid to automatically calculate a further 200,000 points, for each of the red, green and blue channels — resulting in a clear picture, free of colour misalignment.

These features make the Mitsubishi VS-1281E suitable for a wide range of display applications such as video, personal computer graphics and CAD/CAM. List price is \$23,500.00 ex tax.

## Philips first with VGA-input 'Multimedia TV'

Philips has claimed an 'Australian first' in the burgeoning multimedia marketplace, with the launch of its multimedia television (MMTV), a single receiver combining the functions of TV reception with VGA computer input.

The MMTV concept is aimed primarily at young, PC-literate parents keen to see their children take advantage of the powerful learning opportunities offered by computer games, educational software and Internet access.

Philips is offering two stereo MMTV models, with 51cm and 68cm screens. Each MMTV will have its own VGA (Video Graphics Adaptor) input and cable, and also a stereo phono input/cable. MMTV models are expected to retail about \$200 to \$300 above the prices of same size conven-

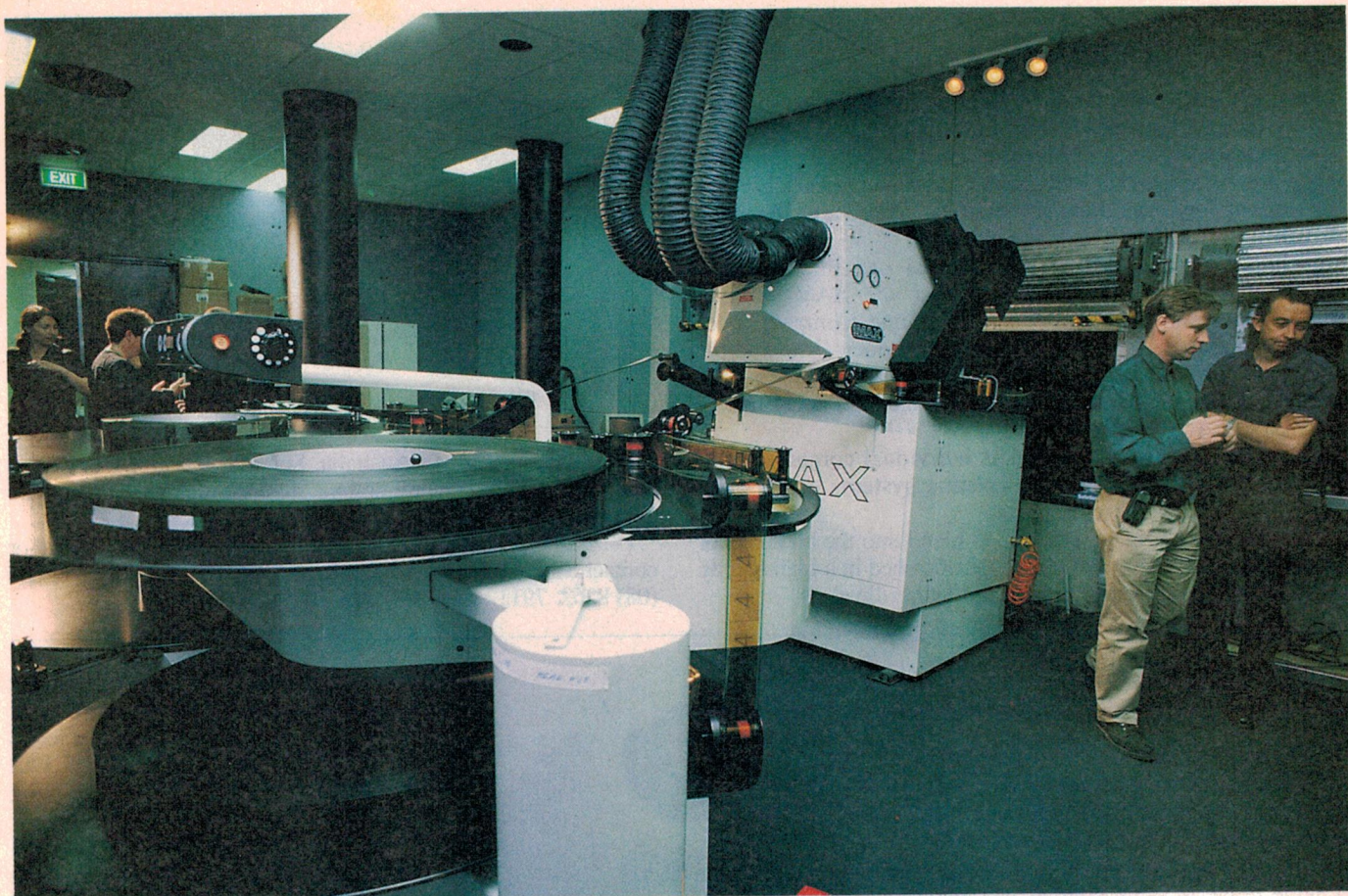
tional television sets. This is quite a saving compared to current new 51cm monitors, which retail at between \$5000 and \$6000.

The sets also include stereo audio amplifiers and speakers, of course, which provide a further saving.

Anthony Toope, senior product manager for Philips Sound & Vision, said that Philips' research revealed "a strong demand among PC users for something bigger and better than the little screens they have had to put up with on their computers," he said.

"MMTV provides an immediate high-end alternative at a very affordable price. This takes the computer out of the study and puts it up front in the most important room in the house, the lounge room where the whole family can enjoy and benefit from it. Once you've had the MMTV experience, there's no way you'll want to go back to a small screen." ♦





# IMAX FINALLY REACHES SYDNEY

After many years of waiting, Australia's largest city has finally acquired its own cinema for the IMAX system, famous for its 'mega-screen' presentation based on horizontally running 70mm film. The long wait has paid off, though, as the new Panasonic IMAX Theatre boasts what is currently the world's largest 2D IMAX screen — plied with images from a massive 15kW lamp, and accompanied by another 15kW of six-channel sound. The sub-bass speakers alone weigh over a tonne!

by **BARRIE SMITH**

Paid a visit to your local LBE lately? LBE's or 'Location Based Entertainments' are all the go world wide — and the big-screen 70mm IMAX 'experience' is leading the push.

Way back in the early 80s, a now-forgotten politician promised that Sydney would have its very own IMAX mega-screen cinema for the 1988 Bicentenary. But much to Sydney's chagrin Perth, the Gold Coast and Townsville won the race and have been enjoying the delights of the format ever since.

But wait — in the 1980s, Sydney *did* actually get the IMAX machinery,

although without the theatre to put it in. And now, somewhat belatedly, the Eastern seaboard capital has finally gained the biggest movie house of them all.

The wait has had one benefit, though, because in typical fashion Sydney has now trumped the rest and gained a cinema with the world's biggest 2D IMAX screen — an eye-gouging 30 x 38 metres. It's also illuminated by the highest powered light source, a 15kW Xenon arc, which is likely to be doubled in power a year or so from now.

The eight-storey \$25 million installation is tucked away in a corner of Darling

Harbour, jammed between a four-lane highway and two expressways. The theatre is a vision in stainless steel, capped with a yellow and black check pattern that has raised the ire of visually sensitive citizens. The venue is officially named the Panasonic IMAX Theatre.

The interior of the 540-seat theatre is acoustically 'dead', to a surprising degree. No external noise intrudes, and while standing outside you cannot hear a decibel from the cinema's 15kW six-channel sound system. The walls and ceiling are matte black, with just a dusting of twinkling stars on the ceiling.

On entry, and while you move to your seat, you'll experience a distinct and worrying disorientation. To one side is the huge white screen, to the other the steeply raked seating — at a 28° incline.

If you take my advice, you'll choose seats in the upper three or four rows. Any further forward and you will find the screen image just 'too much'. Most IMAX cameramen seem to employ ultra-wide-angle lenses (how about a 30mm lens, on the film's 34cm<sup>2</sup> frame?) when shooting — so the viewing perspective in the closer seats is very, very forced!

The image is miraculously sharp and realistic. Some scenes shot in low light have been shot with fast film stock, so grain is just visible. Lumps of dirt on the print are of course wondrously large and sharp. Occasionally you glimpse the corners of the camera's lens hood. It's a BIG format, so any 'defects' show up larger than life as well...

On my first visit I saw a US production *The Living Sea*, which was noticeable for its exciting use of the multiple speaker setup and growling sub bass. However, Meryl Streep's narrative sits uncomfortably in the huge environment, exhibiting a boxy cramped acoustic from the original recording. Music is warm and well coloured, without an excessive top end.

In the first week of public attendance (starting Sept 26, 1996) it was expected that 6000 paying customers would drop their bottoms on the comfy red armchairs. In the last year some 60 million people worldwide saw an IMAX film; since IMAX was founded over 510 million have 'shared the experience'.

The operating company Cinema Plus holds the franchise for Australasia and plans to open six or eight cinemas in the

region. Due in Spring 1997 is the theatre for the \$260 million Museum of Victoria.

## Inside the box

The projection box, on the fourth floor of the building was dedicated to Ron Jones of Brisbane, whose invention of the 'rolling loop' film transport makes the projection of IMAX possible. (See side panel.) I spoke to Technical Supervisor Peter Kehm, who oversees the daily procedures.

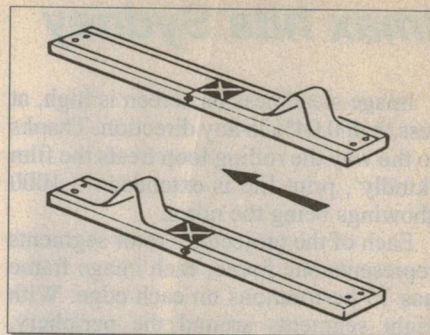
IMAX is a big format so everything is big accordingly. Most productions showcased in the environment are 40 minutes or so in length. The print cost to the exhibitor can be between \$20-50,000 each, plus a royalty on ticket sales.

A reel of IMAX film is over a metre in diameter, weighs 80kg and is lifted onto the projection platters with a fork lift. The print runs horizontally from left to right (facing the screen) to the large white projector itself. Two platter arrays sit atop each other; each can rewind and are exchanged to alternate the showing of different films.

The illumination source of the Sydney IMAX projector is a 420-amp 15kW Xenon short arc, backed by an air-cooled ellipse-based collector mirror, a high voltage starting transformer, starting circuitry, coolant flow controls, air-circulating fan and safety interlocks.

The Xenon lamps are made by only two companies in the world. And the cost? A healthy \$10,000 apiece. The life is around 1000 hours — with 3-4 likely to need replacing annually. In comparison, the IMAX site at Dreamworld on the Gold Coast uses a 4.5kW Xenon.

Currently, Peter Kehm's team are running the air exhaust at 380 litres/second, with a likely lift to around 800 litres/sec-



**An elementary Jones 'rolling loop' setup, showing how the rolling loops advance the IMAX film one frame at a time.**

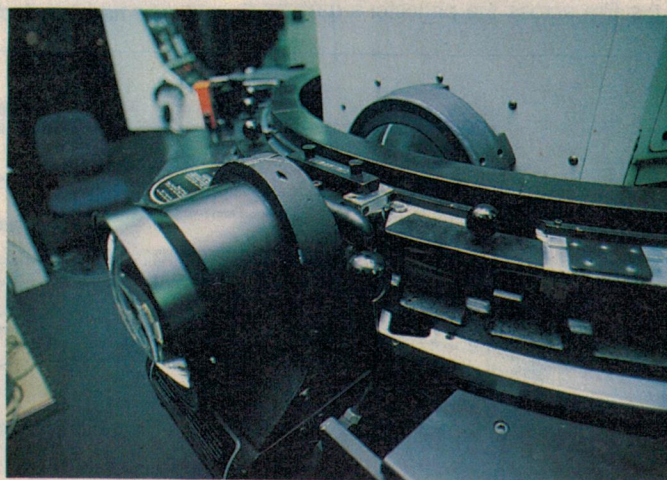
ond for 3D. As he admits, "This is the land of the giants".

Water-cooled piping also feeds distilled water at 150psi (1030kPa) pressure to the lamp electrodes. The lamp-house includes two dielectric coated beam-folding cold mirrors with water-cooled heatsinks, and an air operated, water-cooled dowsers.

Operators are warned not to run the projector without film and with the light source at full power for more than five seconds — or damage to the projection lens will ensue.

## Extended print life

The heart of the projector itself is a 952.5mm diameter rotor. The rotor is intersected with eight windows, each forming a loop or wave in the film as the input sprocket pulls it into the rotor path. The formed loop then advances past the aperture, where a cam and registration pins position each frame at the point of illumination behind the lens. The system closely resembles the closed capstan system of some audio tape recorders.



**Left: Sydney's Panasonic IMAX cinema is tucked between two freeways and a four lane highway. The \$25 million building is eight storeys high. Right: The IMAX lens and rolling-loop film path. The 15kW light source cannot be allowed to pass through the projection lens for more than a few seconds without a film present.**

## Imax hits Sydney

Image steadiness on screen is high, at less than 0.04% in any direction. Thanks to the way the rolling loop treats the film 'kindly', print life is extended — 1000 showings being the norm.

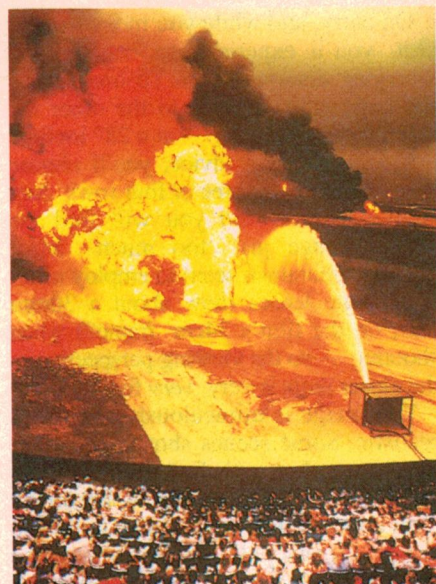
Each of the projector's rotor segments represents one frame; each image frame has 15 perforations on each edge. With eight segments around the periphery, there's three rotor revolutions per second for 24 frames per second, with each frame moving across the aperture in six milliseconds.

It's the rolling loop that actually advances the film — it's always sliding along. The film which has been stationary at the gate is now liberated. As the projector is about to project the second

**Sydney's IMAX theatre employs steeply raked seating, at 28 degrees. The film clip is from a title covering the Gulf War.**

frame the one previously in the gate is moved along, loses its loop and is pulled along by the takeup sprocket. The shutter is two-bladed, so each frame receives a double burst of light and creates a 48Hz on screen image.

The gain of the IMAX screen (ratio of reflected light to incident light) is in the range of 30-40% reflectivity, giving low cross-reflectance, with enhanced colour saturation and contrast. The penalty of a low reflectance screen and its immense area is that you're compelled to use a high intensity light source. The screen is finely perforated over 20% of its area, to allow the multi-speaker array to project



### Kind on the film...

Early critics had claimed IMAX impossible: How could the world's largest film frame be projected without it tearing itself into shreds?

The answer was to be found in a Brisbane inventor's Rolling Loop Projection Movement. Avoiding the violently mechanical pull-down claw that had been around since Mr Edison's time, and the better but still rather brutal 'Maltese Cross' movement used on most of today's cinema projectors, Ron Jones devised a method of driving film motion past the projector's light source that owed much to dynamic geometry, and nothing to Victorian mechanics.

The year 1969 saw Ron Jones deliver a paper to the SMPTE on his revolutionary projector. In place of the traditional intermittent movement shuttling the film in a stop-go motion, Jones' scheme moved the film across the projector's gate as a

series of loops or waves. The film perforations are used only by a sprocket which feeds the film onto the spinning rotor, and then to settle each frame onto fixed registration pins for its burst of illumination — and not to pull the film intermittently. The wave shape is formed by air pressure, with each frame being held against the lens' rear by a vacuum. The result is image steadiness of the highest order.

According to Cinema Plus MD Julie Steiner, "Mr Jones was driving home from work one evening, got caught in rush hour traffic and began to ponder about what you'd do to make film images bigger and smoother. And the concept came to him and it was so simple, that he was afraid that he would forget it by the time he got home. So, once he got home he worked into the early hours of the morning, calculating and drawing. And by the time he returned to his engineering works he knew how to do it. By noon of the next day he had it perfected. He had a working

prototype of the rolling loop created in about 19 hours."

IMAX was first shown publicly at the 1970 World's fair in Osaka. The company now designs and builds not only the horizontally running projector, but also the matching camera. It's also totally responsible for the layout and construction of the purpose-built theatres, now totalling 130 in 20 countries, with a backlog of another 44 yet to be built.

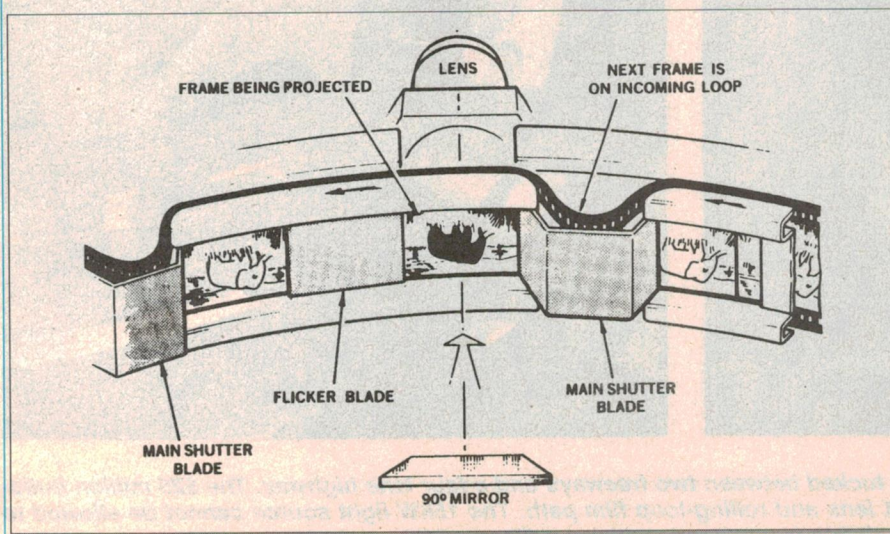
The camera negative is 65mm wide (or 'high' in IMAX terms, as the film runs transversely), and travels at 102.6 metres a minute. Bordered on each side by 15 perforations, each film frame measures 70 x 49mm — a ratio of 1.4 to 1. This is a far more 'square' picture than Panavision's 2.35:1 frame, but nearly ten times the area of the traditional 35mm frame measuring 15 x 21mm, which lumbers along at a stately 27.4 metres a minute.

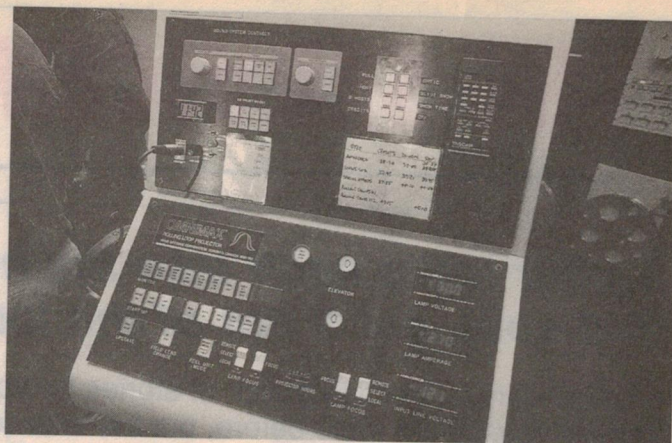
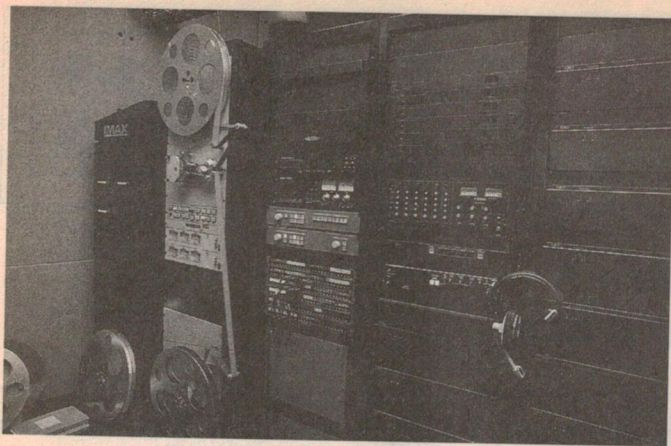
In 1973 OMNIMAX appeared, using a hemispherical screen and a 'fish eye' lens, both at the taking and projection stages — with the viewers' peripheral vision totally encircled.

The company added 3D OMNIMAX in 1985 using polarising or (more recently) LCD shutter spectacles to separate left and right eye images.

Expo returned to Osaka in 1990 and showing were two new processes: IMAX Magic Carpet, and IMAX SOLIDO. The former provides an image on the wall and beneath the audience on the floor; in SOLIDO the screen is domed, the picture in 3D.

So, what's next in IMAX? When asked would the public perceive 3D SOLIDO as just another gimmick, one industry identity joked: "People get used to things so fast. After a while they ask, where's 4D?"





**Left:** The three CD players in the rack at far left are backed up by a standby 35mm magnetic film reproducer. Time code is used to synch the projector to the sound sources. **Right:** The control rostrum for the IMAX projector, audio system and theatre lighting.

its signal without distortion or loss of directional identity.

It is expected that the Sydney IMAX theatre will go '3D' in 12-18 months. To accomplish this a double rotor projector with a 30kW light source will replace the existing one. The two images will be polarised and viewed by the audience using LCD shuttered spectacles.

### Six sound tracks

To supply the accompanying audio, a bank of three CD players is hooked into the system, backed up by a standby 35mm magnetic film reproducer. Each CD carries two tracks, with a total of six tracks carried on both systems plus time code information.

Peter Kehm explained: "The time code sync pulse is generated by a shaft encoder. If a frame of film is lost we have to replace it with a black frame of film."

"Each channel has three amplifiers — very high, mid and low. The sub-bass — below 10Hz — is 3200 watts in power and is driven on all of the six channels. It's filtered and then the sub-bass is fed to an array of eight 18-inch

sub-bass speakers, facing each other. They weigh about a tonne — a tonne of sub-bass. The total output is 15kW."

The projection lens is a Leitz projection optic — an f2.8/38mm, made in Canada.

Asking Peter Kehm for a diagram of

### Not a dime

A Brisbane engineer conceived the crucial projection movement, a Norwegian built the first camera, German optical brains provided the lenses — and Canadian enthusiasm fitted it all together. Neither a dime nor a dollar for IMAX came from Hollywood!

At the moment IMAX are talking to three Australian film makers, including John Weiley, who created *Antarctica* — one of the films in the Sydney venue's roster.

the loop path resulted in a negative reply, with the explanation that IMAX are not keen to release information on the scheme. Apparently, the patent

runs out soon and the company is not anxious to encourage competition. Because of this, IMAX Corporation has patented the guide curve surrounding the feed roller, in an attempt to retain some measure of exclusivity.

Framing is a problem, requiring precise lacing in the projection gate. Unlike normal vertical-path 35mm or 70mm projection, in IMAX an out-of-frame image displays the frameline as a vertical bar. "It's not like an ordinary projector, where you can crank the frame up or down."

Central control is achieved by some deft button pushing on a freestanding command pedestal, between the projector and sound amplifier racks. This unit drives the projector, audio, lighting in the theatre and so on.

### Footnotes

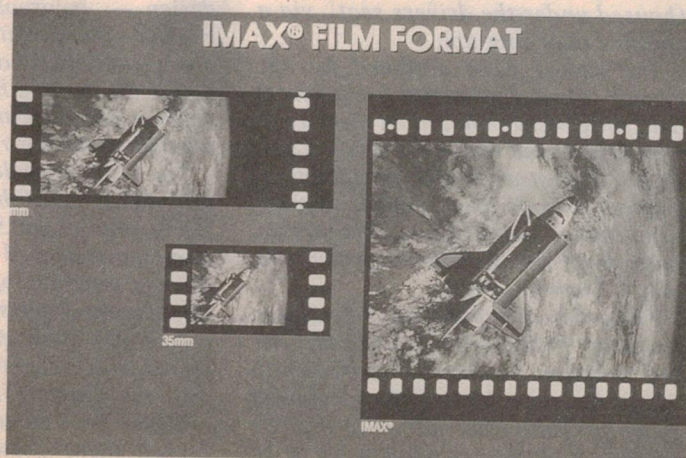
A couple of points of interest before closing. Although Sydney's IMAX projector was in mothballs since the 1988 proposal, it was upgraded to the latest specs for the Sydney opening.

The IMAX system's use of sub-bass frequencies is a result of US Government experimentation during WW2, which found that low frequency emissions over a 20-minute period produced feelings of unconscious anxiety. At one stage the idea was considered as a potential military weapon. Hitler was well aware of the effect, and had low frequency sounds played before his speeches at his monster rallies.

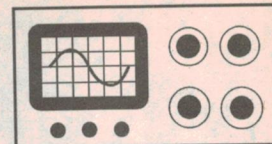
So, if you find IMAX a little worrying as you climb the steep seating, just wait for the movie!

Finally, the practicalities. For booking enquiries at Sydney's Panasonic IMAX Theatre, ring 133 462. The current admission prices are \$13.95 for adults and \$9.95 for children. ♦

**A comparison of conventional 35mm, 70mm and IMAX frames. Note that the IMAX frame is 1.4:1 ratio and occupies 10 times the area of the standard 35mm frame.**



# THE SERVICEMAN



## *If your radio can't take the heat and soot, get it out of the loco's cab!*

I have a very interesting bunch of stories for you this month. We've never had a story about servicing a *real* steam radio before, but that's exactly what our first story is all about. Then we have a tale about a rather unusual use for epoxy resin cement, in 'fixing' an old radio, and finally a story from my own bench about what happened when I finally had to repair one of my CROs. Its focus had been bad for quite a while, but you know what it's like — you only get around to fixing a test instrument when it dies altogether!

Not long after television started in this country, some wag invented the term 'Steam Radio' to describe the old-fashioned pictureless TV. Following on from that, I suppose the definition of 'new-fashioned' TV should be 'Diesel Radio'! All of which is a roundabout way of introducing a contribution that is all about servicing Steam Radio — an original real and genuine steam radio. The story comes from Graeme Clover, of Tawa in New Zealand, and here's what he has to say...

*When I accepted a request to check out, and repair if possible, the VHF 'two frequency' radio transceivers used by a local Wellington NZ railway museum, it was with some fear and trepidation.*

*This was one of those 'love jobs' which*

*one gets from time to time, and you can never be sure just how successful it will be or how much time will be required. However, as a member of the museum organisation, I knew that the repairs would have to be provided at minimum (read 'nil') cost.*

*The transceivers were of an early 1980's design and were mounted in the cabs of steam locomotives built in the late 1930's. The engines were used by the museum for 'main line' excursions some six times a year.*

*Correct operation of the radios was a modern day safety requirement, imposed by Trans Rail (the railway operating company) as a means of communication between the locomotive driver and the Train Control Office. Two-way radio has replaced the old telegraph and telephone lines once so common alongside railway tracks almost everywhere.*

*The power supplies for the radios are of interest in themselves. The 32V DC from the steam turbine mounted on top of the locomotive boiler is used to charge a 12V lead-acid car battery (housed under the drivers seat), via a suitable charging unit.*

*The radios were designed for the cleaner diesel locomotive environment and, since being mounted on the narrow wall behind and above the driver's seat in the cab of steam locomotives, they had suffered considerable cosmetic damage from smoke, soot and heat. The firebox opening of the locomotive boiler was only 1.5 metres away!*

*The action of 'lighting up' the locomotive using firewood thrown into the firebox, and then coal as the fire increased, was a major problem. Before sufficient steam pressure was built up to activate the blower, flame would billow out of the*

*firebox opening back to and up the wall behind the driver's seat, scorching the radios in the process.*

*No amount of pleading with the amateur 'light-up' crews, to remember to protect the radios from the flame and heat, seemed to work. The solution ultimately adopted was to revise the mounting arrangements and keep the equipment out of the cab during all of this activity.*

*In this way, with a 'quick-fit' mounting provided, the radios could be rapidly replaced before the locomotive departed on an excursion, by which time the worst of the smoke and heat problem was over.*

*After that, the problem became one of vibration. Which, if you have never ridden in the cab of a steam locomotive travelling at speed, has to be experienced to be believed. The locomotive literally pounds its way along the track with incredible vibration.*

*So much for the background. Now on with the story proper...*

*The radio transceivers are an AWA NZ Ltd model (TR245) of an interesting design — incorporating a 'scanner' channel control unit with a loudspeaker and a handset held on a cradle, mounted beside the driver's head. The scanner is connected to the transceiver proper with a length of 26-way ribbon cable.*

*The scanner is designed to scan the four designated channels, Channel 1 being simplex (at 3W reduced power) and Channels 2, 3 and 4 for two-frequency repeater operation (at 15W). The channels are scanned at approximately five times per second and if a signal is detected (i.e., 'mute' activated), the scanner is stopped on that channel for about five seconds and locked there should the handset be*

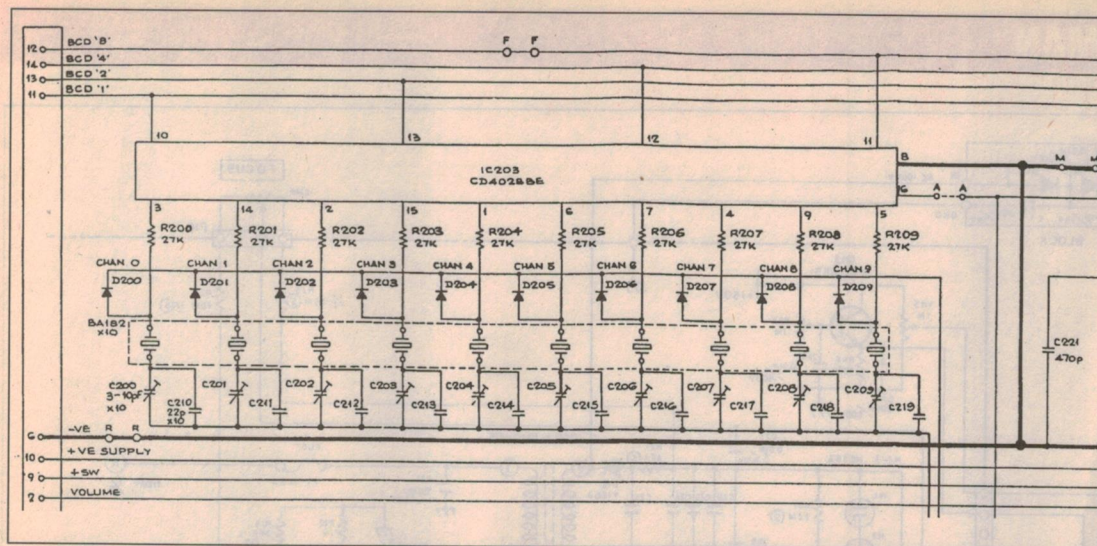
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Part of the scanner logic circuitry for an AWA NZ Ltd TR245 transceiver, which forms the subject of Graeme Glover's story. The 4028 chip is used to select one of the 10 crystals, under the control of the BCD lines at the top.

taken off the cradle.

When the scanner is switched off, channel selection is available via a rotary BCD switch providing output directly to the three BCD control lines. The reported fault was that one of two transceiver sets had failed to operate correctly when used on the last trip, and the other was in an unknown condition.

Urgent repair was required in time for the next excursion, and when the job was under way a third spare transceiver (one whose existence I had not previously known of) was produced. As luck would have it, this one also proved to be faulty — but that's another story.

I was fortunate in obtaining from a sympathetic source a spare transceiver cradle (to provide a test setup away from the filth of the locomotive cabs), and the circuit diagrams of the transceiver and scanner. This revealed very straightforward CMOS digital logic circuitry in the scanner and RF circuitry in the transceiver.

A three-line BCD signal connection to the transceiver is used where separate CD4028 'BCD/1 of 10' decoder IC's are used to select the particular channel crystals for the transmitter and receiver.

A CD4511 'BCD/7 segment' display IC driving the single red LED 'channel indicator' is connected directly across the three BCD channel control lines, thus providing a very useful diagnostic tool. This was relevant in that one set was indicating that the BCD '2' line was permanently high (i.e., displaying '3' for 1, 2, or 3, '6' for 4, '7' for 5, etc.). See the attached copy of the scanner and crystal control diagrams.

I wondered how I might adequately test these sets, since I am not a radio technician — merely an electrical engineer with some electronics experience but no radio test equipment.

Using an old car radio aerial as a spare antenna (the low profile 'Philips' antennae were still attached to the locomotives), I found that the receive function on all three sets appeared to work correctly on at least two channels.

These were the channels normally used in the area (channels 1 and 2), as I was able to hear the Train Control voice traffic. However, it was accepted this was not a conclusive test, for the other two channels were not being tested.

I was able to borrow a well-used Bird (brand) RF Powermeter and a 50 ohm dummy load, which revealed that one set did not produce transmit power on some channels, whereas the other set (previously pronounced faulty) produced correct power output on all four channels.

There was one more trick to try. From the markings on the crystals ('12x' for the transmitter and '3x + 10.7MHz' for the receiver), I determined the channel frequencies and set up my trusty little handheld scanning receiver on the receive frequencies corresponding to the transceiver transmit channels.

Using the leakage from the dummy load, it was quickly proved that this set was transmitting the wrong frequencies for channels 2 and 3 according to the scanner channel display, but the correct frequencies for channels 1 and 4.

I had previously told an interested audience at the museum that if the trouble was in the scanner digital logic, then the faults were probably easily fixed. But if the trouble was in the radio section, I had better take it to a radio expert, as I knew my limitations.

However, on reviewing the situation, it soon dawned on me that the fault was clearly digital. Sure enough, an input/output logic state check on the transmit 4028 decoder crystal IC of both transceiver units showed discrepancies.

Further, cutting the BCD '2' input leg of the IC in the transceiver with the BCD '2' line permanently energised, removed the fault. Obviously, both IC's had to be removed — not an easy task for my old solder sucker, and especially for the one on a 'plated through hole' board.

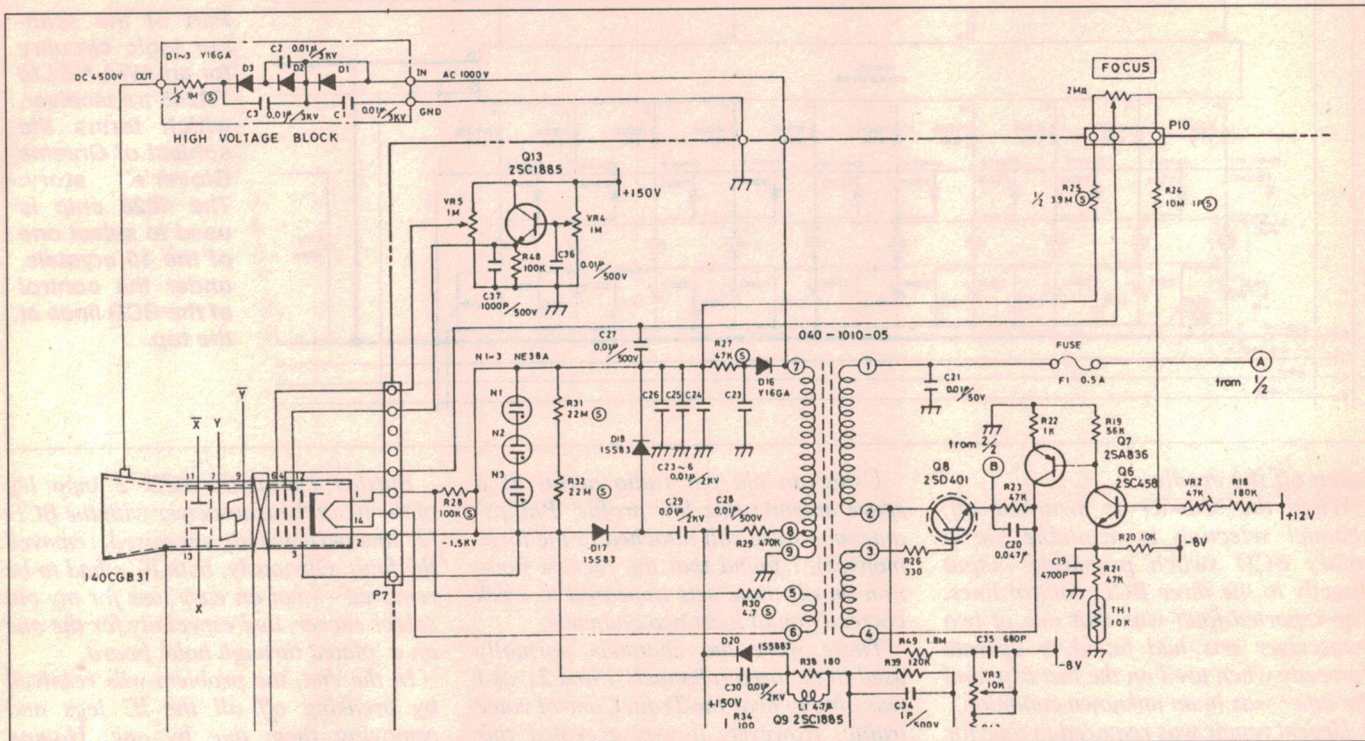
In the end, the problem was resolved by breaking off all the IC legs and removing them one by one. Having replaced both IC's with \$2 replacement 4028 chips from DSE, the sets now transmitted with the correct power and frequency on all four channels.

This left the receive function to be fully tested. I had been able to prove the operation of channels 1 and 2 by listening to the local Train Control operation, but proving channels 3 and 4 had to wait until the day the locomotive was out on an excursion and in the relevant areas.

Lastly, I returned the equipment to the cabs of the locomotives for an in-situ transmit test with the power meter. This revealed minimal 'return' power from the antennae — suggesting that the antennae were alright. Even this test was difficult, because with the locomotives stored inside the shed, so little light was available in the cab that torches were needed to check the connections.

Why the same IC was faulty on both transceivers remains a mystery, as they were both of different manufacture. Maybe the heat from the locomotives and the stray internal RF power from the transmitter had 'done them in'. In any event, my prestige among the museum members went up a notch or two, although I may not be so lucky next time.

See what I mean about 'genuine Steam Radio'? I'm particularly grateful to Graeme for that story, as I am one of those nuts who will travel all day just to watch a steam train go by. I'm also a bit jealous of his good for-



Shown here is the most of the power supply circuitry for the Serviceman's own Meguro MO-1252 scope, which had poor focus for some time — but didn't get attention until it stopped altogether (funny about that!). The cures for both problems turned out to be simpler than he feared, though...

tune in being able to ingratiate himself with the local railway museum. Some people have all the luck!

Thanks, Graeme. And if you have any more railway stories, let's hear from you.

## Things people do...

And while we are still in New Zealand, let's take a story from our regular correspondent Peter Lankshear. As you know, until recently, Peter conducted the popular 'Vintage Radio' column in this magazine, and a few months ago contributed to this column with a story about cordless telephones.

He has now sent me about five or six shortish items which I think I'll spread over the next few months. As might be expected, Peter's subjects are all about (steam) radio, but I feel that they are relevant to any era of electronic servicing. Here's the first one. See what you think:

*I am pleased that my story about the mobile telephone was considered interesting enough to be included in the March '96 issue of EA, and I am taking you up on the invitation to share some more experiences. These will be, naturally, about older equipment, but not so specialised that they should rightfully belong in the Vintage Radio column.*

*The first one I would call 'The Things*

*People Do to Radios'. During the 40-plus enjoyable and satisfying pre-retirement years that I spent in full time radio work, I maintained broadcasting studio as well as radio and TV transmission equipment, all built to very high professional standards.*

*Consequently, I did not have to suffer a lot of the tribulations encountered by the traditional serviceman in his day to day dealings with the public and their problems. It was therefore, a bit of a culture shock when in retirement I encountered some experiences that come with servicing domestic radios.*

*I suppose that there is more of an element of do-it-yourself attached to an old valve radio, encouraging a bit of probing and poking. But it still amazes me how often I find all accessible adjustable capacitors and inductors screwed up tight — even when it is obvious that the culprit had to go to some trouble to break through wax sealing to get to the screws. I have even found every ferrite core in the IF transformers of a receiver shattered, by someone 'trying to get it going'.*

*On one occasion a receiver in the local auctioneer's 'Alladin's Cave' took my fancy. The set was in pristine condition and as I would have overhauled it anyway, I wasn't concerned*

*about its operating condition. Accordingly, I purchased it 'as is — where is' state without trying it out.*

*With the chassis on my work bench, I set about a preliminary checking and a violet coloured glow, an unmistakeable indication of a gassy rectifier, was immediately obvious. This could well have been the original problem. With the rectifier replaced, there seemed to be very little else wrong, but the set remained strangely silent.*

*There was just no sound at all from the loudspeaker. Full HT voltage was present at the anode of the output valve, indicating that the most common silencing fault, an open-circuited output transformer, was not the problem. It seemed therefore that the likely place to look was the voice coil.*

*I imagine by now most readers with servicing experience will be saying, as I did, "Ah yes — a dry soldered joint in one of the eyelets terminating the flexible pigtails".*

*With the speaker removed from the cabinet, the problem was immediately apparent and it certainly did affect the voice coil. In fact it had been carefully glued to the pole piece, with the gap completely full of epoxy resin! One can only guess why this had been done. Maybe the*

*perpetrator had decided that the buzzing noise generated by the faulty rectifier was due to a loose speaker cone...*

Well, there you go! I must say, although I have come across some weird 'fixes' with the same general result as Peter describes in his story, I can't say I have ever seen a voice coil 'epoxy'd' into place. Perhaps we should ask Selleys to remind users that Araldite is NOT suitable for repairing loudspeakers!

Thanks for that story, Peter. As mentioned above, there will be more to come in the next few months.

## Fixing the CRO

Now for another tale of woe from my own bench.

There was once a time when a serviceman only needed a screwdriver and a moderately complicated multimeter, to solve any problem in domestic electronic equipment. To complete the repair he only needed a soldering iron — and perhaps a hammer, to knock things back into shape!

Times have changed and most of us now have a stable of delicate tools and intricate test equipment, including oscil-lators, generators, meters and the inevitable CRO. It's this last instrument that is the subject of this story.

My first scope was a 'University' instrument, featuring a two-inch screen and a bandwidth of 50 cycles to 20 kilo-cycles per second. (Hertz hadn't been invented then!) This was a totally reliable tool and quite adequate for the limited audio response of the day. It served me well for over 10 years.

When I returned to servicing about 1974, colour TV was on the horizon and I needed a much better CRO. I've always preferred to buy Australian when I could, so I purchased a BWD model 539. This was a nominal 10MHz instrument, but mine actually tested to 15MHz.

(This was quite remarkable for its time and is indicative of the skill of Australian design and manufacture. Unfortunately, BWD couldn't keep up with the changes in Government policies, and the brand appears to have faded from sight.)

I was inordinately proud of my BWD. It was as good as any CRO on the market, and better than those in the workshop of most of my contemporaries. It had cost me an arm and a leg, but proved its worth many times over in day to day practise in the workshop.

It wasn't until the late 80s, when I became involved with VCR service, that I felt the need for a newer, more versatile CRO. It was about this time that the old BWD spat the dummy, for the first and only time in all the years it

has lived in my workshop.

I turned it on one day, to be greeted by the most fiendish odour one can ever encounter. It was vile! The foul smell was eventually tracked down to a shorted selenium high voltage diode. A silicon replacement restored the old 539 to full operation, but the stink hung around the workshop for days.

The breakdown in the BWD might have been induced by the frequent movement from the TV bench to the VCR bench and back again. So I resolved to get a new instrument for the latter spot. I chose a Japanese made 'Meguro' MO-1252, a dual beam 35MHz instrument that cost much the same as I had paid for the old BWD, about 15 years earlier!

The Meguro had a lot more features than the older scope and soon proved its worth in solving some tricky servo and chroma problems in video recorders.

The instrument worked well for two or three years. Then one day I noticed that the focus was slightly off and the control was not working. The trace was still clear enough for most work, so I made a mental note to fix it one day when I wasn't quite so busy. Of course, that day never came and it wasn't until the scope stopped working altogether that the focus problem was eventually sorted.

The 'Meguro' finally dropped its bundle on the busiest day of the week, so the old BWD once again wandered from bench to bench and kept on working as well as it had ever done.

A few months ago a contributor wrote about a technician's own TV being the last to get attention. A similar condition applies to a technician's tools of trade. My scope had to wait until after knock-off time, nearly a week later, before it could get some attention...

In a way, it was a good thing that I started the job in the early evening. With the cover off the CRO and most of the workshop in semi-darkness, it was easy to see that the tube heater was not alight. At first, I had a sick feeling because with power on and no heater, my thoughts went like 'open circuit heater = new tube = big expense'.

Then good sense took over, and I recalled that a similar symptom in TV sets usually results from a dry joint somewhere in the heater supply circuit.

One good feature of the Meguro scope was that the user manual incorporates a full service manual, with circuits, board patterns, parts lists and full adjustment details all supplied. It's a pity we couldn't get that sort of service from the TV companies!

This scope uses a number of supply rails, both low and high voltage, positive

and negative, some derived from the 50Hz mains and some from a self-oscillating chopper supply. It's a monstrous circuit, but once the general plan is understood, it's not too hard to follow.

The rail I was interested in was picked off the chopper transformer at pins 5 and 6. It's then fed via resistor R30 (4.7Ω) to pins 3 and 4 on plug P7. This supply is AC at quite a few kHz, and my multimeter didn't respond very accurately to that kind of source. So the old BWD scope had to be pressed into service, to fix its much younger counterpart.

I was able to trace the supply right up to P7, and my earlier visions of an open circuit heater reappeared. I checked for continuity at the plug, hoping to see something like the 1.5Ω resultant of a 2Ω heater in parallel with the 4.7Ω series resistor and the transformer winding. In fact, all I saw was the 4.7Ω resistor, which confirmed that the heater must be open.

With sinking heart, I pulled the plug and tested from pins 3 and 4, expecting to see the open circuit heater. But wonder of wonders, I got a neat 2Ω — which suggested that the heater was not open after all. So what now?

I refitted the plug and once more the circuit to the heater was open. Then the penny dropped. I took a 10X loupe and peered into the openings along the front face of the plug. Most of the openings were closed off inside by a springy metal contact, but one of them, pin 3, was empty. The contact had broken off inside the plug housing.

This particular kind of plug was very common in early VCRs but I have never seen one fail in this manner. I can only suspect that it had something to do with corrosion caused by the fact that the heater supply was returned to the tube cathode's 1400V negative rail. Negative terminals do seem to corrode more often than positive ones, so that could have had a bearing on this fault.

While I had the scope opened up, I pulled all the other plugs and gave them a thorough examination. I found only one other damaged pin — on P10, leading to the focus control!

I salvaged a plug from an old Beta VCR and removed two of its pins. In no time at all I had replaced the damaged ones in the scope and had it back in full working order.

So there you have it. Two breakdowns in two instruments, in a total of about 30 years of service. I'd say that's pretty good reliability. Wouldn't you?

That's all for this month. There'll be more stories from the Serviceman's bench, next time. ♦

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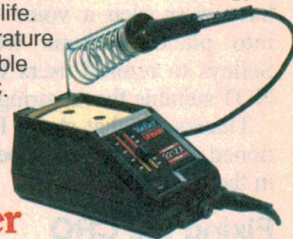
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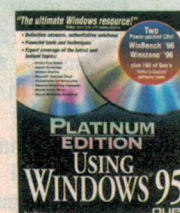


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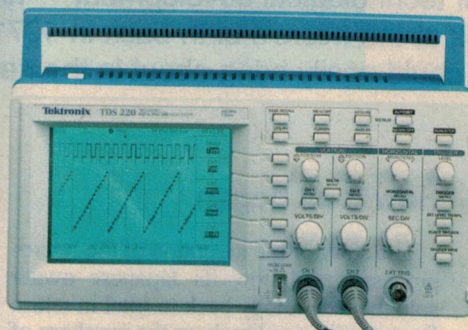
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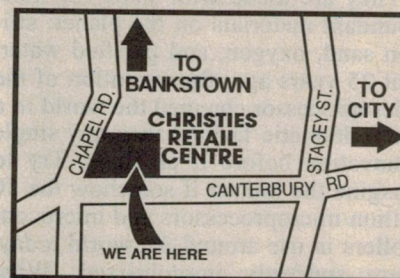
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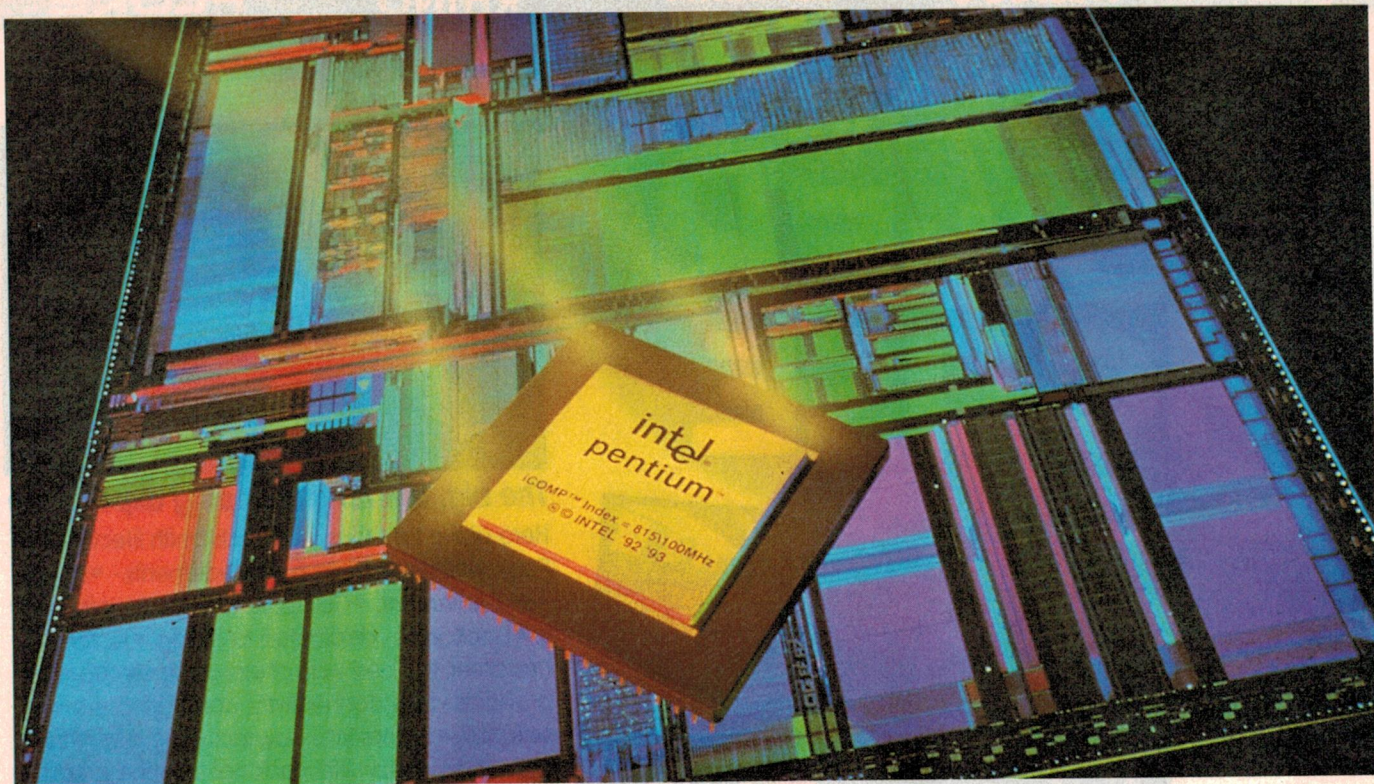
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*The Incredibly Successful Microprocessor:*

# ONLY 25, BUT NOW CONTROLLING THE PLANET!

In its relatively brief span of 25 years, the microprocessor chip has already had a greater impact on human civilisation than any other technological development — and that impact is still growing at a bewildering speed. Here we look at the micro's birth back in 1971, the developments it has made possible since then, and what it could easily bring about in the next phase of its 'working life'.

by **PAUL SWART**

They are made with some of the most abundant materials on the planet: silicon sand, oxygen, and purified water. But 25 years ago, the invention of the microprocessor changed the world in a more dramatic fashion than any single innovation before it or since. Try to imagine the impact if somehow the 50 billion microprocessors and microcontrollers in use around the world today, were suddenly immobilized. What aspects of our society would still be able to function uninhibited?

According to Dataquest figures released last year, the worldwide microprocessor market will become a US\$32 billion business in 2000, more than double the 1995 market of \$14.5 billion.

## How it all began

The story of the invention of the microprocessor and how its Japanese owner sold the technology back to Intel in return for a small price break on the purchase of 4004 processors, is one of Silicon Valley's most classic high-tech legends.

The idea for a microprocessor was first conceived in 1969 by a chip design engineer at Busicom, a Japanese calculator company looking for ways to reduce the number of chips on the circuit boards of its products. Busicom contracted the design of the chip out to Intel, which assigned three of its top engineers — Federico Faggin, Ted Hoff and Stan Mazor — to develop the first

'computer on a chip', under a US\$40,000 contract.

The first of the Busicom chips, after a nine-month development effort, were shipped in early 1971. For a few months, the Japanese company held the exclusive right to the patents on the most important invention of the century, perhaps ever.

The advantages of the microprocessor, however, didn't give Busicom the cost reductions it had hoped to achieve by combining a number of calculator functions onto a single chip. Busicom went back to Intel to negotiate a better price for the chips. Intel, which had since realized that it had a marketable product on its hands, agreed in return for ownership of the microprocessor tech-

nology. Busicom agreed, after Intel also offered to reimburse Busicom the full \$40,000 it had put up to develop the chip.

Ironically, Intel was a rather unlikely candidate to produce the chip Busicom was looking for. At that stage Intel was still a very small company, struggling in the then already volatile DRAM memory market, where its 1024-bit DRAMs were state of the art. Its engineers had no experience in designing and producing custom chips, especially not a chip unlike anything ever seen before.

But Intel was eager for business in those days. And it had Ted Hoff, a young visionary who convinced his bosses to get the Busicom contract.

Hoff's pitch to Busicom was as unusual as anything surrounding the microprocessor development. Instead of simply working with the customer's chip specifications, Hoff nearly insulted the potential customer by throwing out Busicom's specifications, saying they were too complicated, too product specific, and Intel didn't know how to make custom chips anyway.

Instead, Hoff proposed something entirely different. He had been using a Digital Equipment computer to design chips. The system featured an elegant system architecture and a relatively simple instruction set. Why not, Hoff argued, do the same thing on silicon and produce a *general purpose* computer chip set?

Initially, Busicom thought Hoff was out of his mind and turned the idea down. Convinced it was the best solution, Hoff took his case straight up to company founders Gordon Moore and Robert Noyce. The two men agreed to let Hoff continue to work on his design. Pressed for a solution, Busicom unexpectedly changed its mind and decided to put up \$40,000 to back the Intel project. By October 1969, the 4000 microprocessor project was under way.

### Who'll buy them?

The 4004 chip almost never made it to market beyond Busicom, as Intel considered abandoning the microprocessor. At the time, in mid-1971, Intel was unable to figure out just who would want to buy the 4004 chip. That was until it hired Ed Gellbach, a marketing manager who came to Intel from Texas Instruments. Gellbach convinced his boss Robert Noyce that the microprocessor was indeed a marketable product.

Shortly afterwards, Hoff and Noyce took off on a road show to sell the idea to Intel customers, most of whom imme-

diately bought into the product. Finally, in November 1971 — 25 years ago — the 4000 family was introduced as a commercially available product. It was followed five months later by the 8008, the direct ancestor of the modern Intel Pentium Pro microprocessor, by means of the 8080, the 8086, the 8088 (the heart of the IBM PC), the 80286, 80386, 80486, Pentium and ultimately the Pentium Pro.

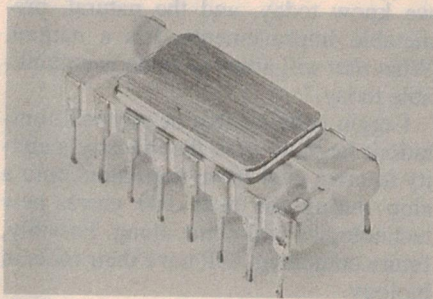
Intel's 4004 was followed a few months later by the first microprocessor from Texas Instruments, whose single-chip processor gave ordinary consumers their first taste of microprocessor power with 'intelligent' consumer products such as toy tanks that could be programmed to follow a certain path, and

the 'Speak 'n Spell' learning toys that became a hot item in the late 1970s.

### Inventors surprised

Today the impact of the microprocessor on our modern society is nothing less than all-encompassing, and far greater than the original inventors ever imagined. Recalls Faggin: "One of the most difficult things is predicting what a major technology can do. Could the Wright brothers have foreseen that 60 years after they were building the first plane, we would have been landing on the moon? It's similar with the microprocessor. Today, what we see are the consequences of consequences of consequences."

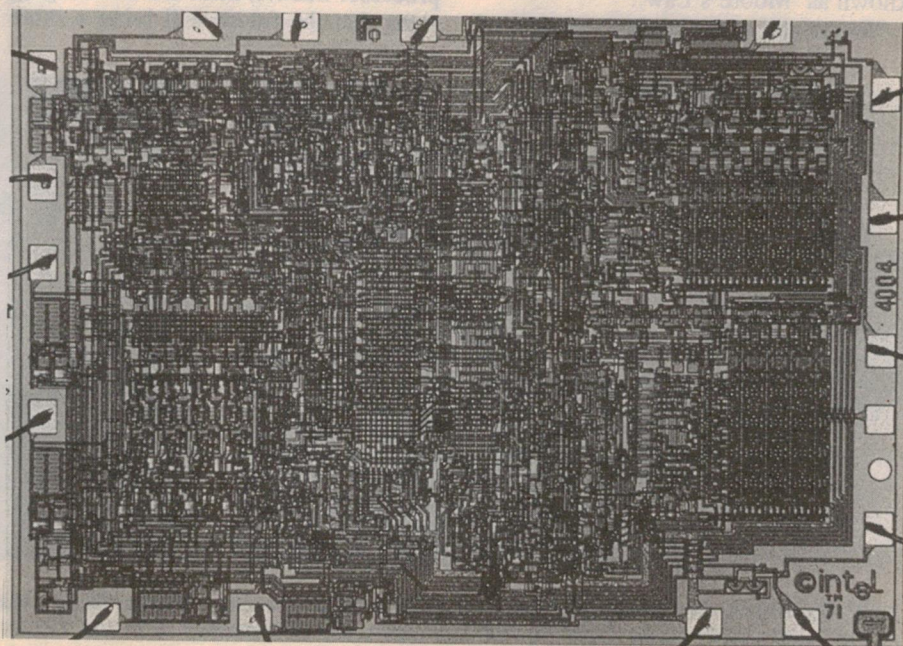
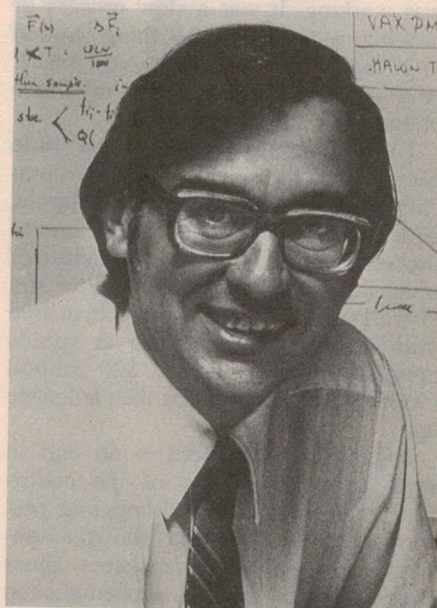
"It was clear to me that you could



**Top:** The 4004 was supplied in an unassuming 16-pin ceramic DIL package — a far cry from the PGA packages used for its modern descendants.

**Right:** Dr Ted Hoff, one of the trio of Intel engineers who designed the 4004.

**Below:** A closeup view of the die for the original 4004 microprocessor, designed by Intel engineers Frederico Faggin, Ted Hoff and Stan Mazor.



## The mighty micro

make desktop computers with the microprocessors and that they would be quite powerful. But the image that I had was more for calculating, for scientific calculators, as opposed to the multimedia machines that you see today. Those are applications that are born out of many levels of improvement, and as such, I don't think anyone would have been able back then to predict all this."

Faggin clearly remembers the day, or more precisely, the night, in January 1971 when the microprocessor was born. "It was past 3am by the time everything was working right on that first chip set, and I had just received the wafers, which back then were only two inches in diameter. I set out to see if it was working. It was a slow process of probing, of seeing if this thing worked or if that thing was in the right place. And as it was coming to life, my sense of euphoria was increasing."

Today's microprocessors bear little resemblance to the first computer-on-a-chip ICs from Intel, TI and Motorola, which launched its first 6800 microprocessor in 1974. From a handful of transistors, today's Pentium Pro and PowerPC chips contain more than five million transistors and run at speeds approaching those of the \$20 million Cray supercomputers less than a decade ago.

Faggin believes there is no end in sight to the evolution of the microprocessor along its mind-boggling performance path, which has shown a doubling in speed and transistors about every 18 to 24 months, a phenomenon known as 'Moore's Law'.

"We're still at the beginning stages of

the movement toward informatisation, or whatever you want to call it, that will continue for the foreseeable future. Because of the continuing acceleration of the technology, and the rapid succession of generations, we will have even more unpredictable consequences in the next 25 years than we had in the first 25."

"Just think, 35 years ago we were making one transistor. Then, a few years later we could make 10 or 20 per chip. We've gone from 10 transistors to 10 million per chip today. That's a factor of one million in 35 years. We will slow down a bit, but there's still another factor of a million to come in the next 50 years. That means we will make a chip that has 10 trillion transistors! And that is with the semiconductor technology we know today, and the natural, predictable improvements. It's a natural. What *that* will allow us to do is unthinkable today."

Faggin believes that as physical limitations begin to slow the industry's ability to cram ever more transistors onto a chip during the next 100 years, new technologies will come along. Possibly, future computers will have their roots in biology.

"Biology is making incredible progress, and maybe in 100 years we will have biological computers which have fewer limitations than the technology we are using today. Perhaps they will manufacture themselves!"

### Bigger than Intel

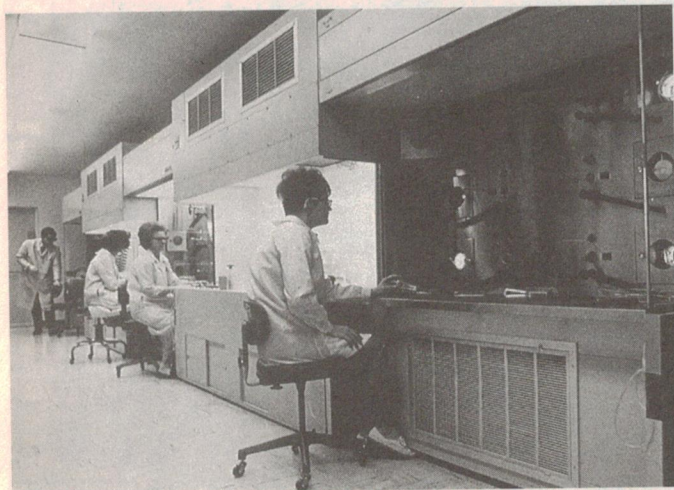
While most of today's microprocessor industry revolves around Intel, which controls more than 80% of the microprocessor market, there are encouraging signs that the future will bring a more



**The three founders of microprocessor giant Intel, pictured in the 1970's. Left to right are Dr's Andy Grove (current President), the late Bob Noyce and Gordon Moore (current Chairman).**

diversified market. At the recent Microprocessor Forum in San Jose, for example, a host of new microprocessor innovations were demonstrated or described, including:

- Exponential Technologies in San Jose described its PowerPC-based X704 chip, which has been clocked at a stunning 533MHz. The company expects Macintosh-based computers built around the chip to be in stores during 1997.
- Advanced Micro Devices and Cyrix showed off their K6 and M2 chips, which will compete with Intel's Pentium Pro.



**Left: Manufacturing semiconductor chips at Intel in the early 1970s. Right: Manufacturing semiconductor chips at Intel in the 1990s, with clean room conditions that were undreamed of in the 1970s.**

- Sun Microsystems described the first Java processor, which could spark a revolution in Internet-based US\$500 network appliances.
- Multimedia microprocessors from Samsung, Fujitsu, LSI Logic, and MicroUnity hope to capitalise on market demand for chips that provide advanced new multimedia capabilities, at a fraction of the cost of today's add-on boards and peripherals to perform such functions.

## Hard to predict

Far more difficult to predict than the technological progression of microprocessor technology, Faggin agrees, is the social consequences on our society and ways of life.

"The fact that society changes at a slower time scale than the successive generations of our products creates a lag. You end up having a more powerful microprocessor and computer than people can actually adapt to and use. So we will see a delay in the social consequences. I predict that the social consequences of the microprocessor, 50 years from its inception, will be substantially larger than what we can detect today."

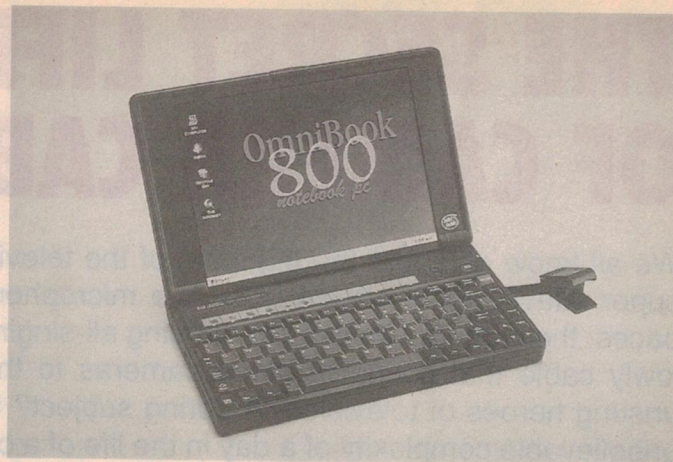
"Only now is the Internet creating opportunities for interaction between people that will give a sense that something new will emerge from all this work."

Already, the number of microprocessors and microcontrollers that are parts of our everyday life is stunning. Just consider the number of microprocessor-operated devices one can find in the average middle-class household these days: TVs, remote control devices, personal computers, printers, fax machines, video game controllers, personal organisers, remote-controlled toys, still cameras, video cameras, VCRs, home stereo systems, portable CD players, portable radios, wrist watches, calculators, clocks, bathroom scales, microwave and regular ovens, washing machines, dishwashers, refrigerators, alarm clocks, telephones, cordless and cellular telephones, answering machines, pagers, and coffee makers...

And, of course, the automobile — which already contains a dozen or so microprocessors. That number is expected to increase sharply in the coming years, a trend that prompted Intel to announce recently that it has initiated a program to develop advanced new Pentium-based chips for automotive applications.

Part of the problem in predicting the consequences of the microprocessor is that never before has a society turned itself over so completely to a single new innovation. Even the telephone, radio,

*Just one aspect of the enormous microprocessor inheritance: a modern laptop PC, the Hewlett-Packard Omnibook 800, based on a 133MHz Pentium processor from Intel.*



television and aviation revolutions took far longer to develop, and have influenced society in a far more limited way than the microprocessor — whose widespread use didn't come into focus until the early 1980s.

## Leader and dwarfs

One of the most incomprehensible aspects of the microprocessor revolution is that it has remained controlled by a handful of companies. And of those, Intel reigns so supreme that comparisons with its competitors are an effort in futility. Instead, Intel's competitors AMD, Cyrix and — until it was bought up by AMD — Nexgen, are little more than pilot fish swimming around giant Intel, trying not to be eaten by litigation usually filed by Intel.

And then there is Motorola, which lost the battle for control of the microprocessor market when its 68000 family of chips couldn't keep up with Intel in the fierce one-upmanship microprocessor battles the two companies fought in the mid-1980s. Motorola's 68000 family fell too far behind Intel's chips, starting with the 68030 which lagged Intel's 80386 chip.

Motorola is attempting to make a comeback, with the PowerPC line it developed with Apple Computer and IBM. But to succeed, the PowerPC will need to become more broadly used than by its current predominant customer, Apple Computer.

Of course there are many other microprocessor makers, including powerful RISC-based chips from Hewlett-Packard, MIPS/Silicon Graphics, the UltraSparc from Sun Microsystems and the Alpha chips from Digital Equipment. These, however, are aimed mostly at higher-level minicomputer and engineering workstation markets whose numbers are counted in hundreds or thousands, not tens of millions.

In retrospect the development of the microprocessor was as inevitable as that

of the integrated circuit, a dozen years earlier. Just as in the late 1950s, when individual transistors were connected on circuit boards in increasingly complex wire schemes, computer circuit boards in the 1960s featured ever greater numbers of single-function chips. The development of the integrated circuit brought multiple transistors together onto a single chip. Likewise the microprocessor represented a simplification of computer CPUs by integrating numerous functions onto a single chip.

What set the Intel 4004 apart from other multi-function chip efforts at the time was that rather than a product-specific IC, the 4004 microprocessor functioned as the central processing unit for broad range of applications.

It didn't take long for the industry to realize the microprocessor meant a revolutionary breakthrough. For a small price it brought 'intelligence' to manufacturing, service, packaging, marketing and management. Products incorporating on-board microprocessors were able to change, learn from their use, teach their own operation, and adapt to the user. Most of all, they could steal the market away from their 'brain-dead' competitors.

Microprocessors also changed the business environment, into one in which companies which survive and thrive are those that can move fast, learn quickly, link up with business partners, and change their shape at will.

Working for these new companies is, by necessity, different from traditional jobs. Employees today find themselves working on the road or from their home, linked to their company by their laptop computers, pagers and cellular phones. And the microprocessor is responsible for the trends toward 'corporate downsizing' brought on by microprocessor-based information systems that eliminated entire levels of middle management.

*Continued on page 79*

# THE SECRET LIFE OF CAMERA CABLES

We all know all about the big stars of the television technical world — the megawatt lights, the super suave digital effects units, the microphones that can hear a flea cough at one hundred paces, the cameras on their all-dancing all-singing computer controlled pedestals. But what of the lowly cable that connects those cameras to the outside world? Camera cables are the great unsung heroes of television. A boring subject? Not on your life! Read on and find out about the unbelievable complexity of a day in the life of a camera cable. Read about the life and death decisions, and about their touching devotion to duty...

by **BRYCE TEMPLETON**

If you're not intimately involved with them, camera cables are a bit like bicycle wheels. They exist and work well, but your last thought as you lay down your head at night is probably not going to be 'and God bless all the camera cables'.

So, for the 99.9999% of the population who have never given them a moment's thought, here is an expose of the world of the Camera Cable.

First of all, we're talking here about *real* television cameras. The big ones you see at the footy, or when you go and watch the recording of *Hey Hey its Saturday*. You may have even noticed the cable, just sort of hanging there out of the side of the camera, all orangey-red. They even have their own handling person, to keep them untangled when the cameras move a lot. Ever wondered how they work? No? Well I'm telling

you anyway...

First a little history. In the black and white television days, the television cameras used valves, high voltages, and were very bulky. The early models followed the techniques of 35mm film cameras, and were self contained. But the tube that converted the light into an electrical signal, the image orthicon, was itself about 450mm long by 200mm in diameter. So when the dozens of valves, several transformers, and hundreds of small components were added, the resulting camera was very large and unwieldy.

But the camera cable was simple. Just a couple of wires for power, and a coaxial cable for the outgoing picture. However, for live television, which was all there was, the cameraman required communications, so a few more wires were added to the cable for headphones

and a carbon microphone.

Then an electronic viewfinder replaced the optical one. And, since this is nothing more than a television monitor, it could be switched either to an external signal, such as the outgoing mixed picture, or the camera's video output. This enabled the cameraman to see how his shot was being incorporated into the overall production. So another coax was added to the cable to carry this return video signal.

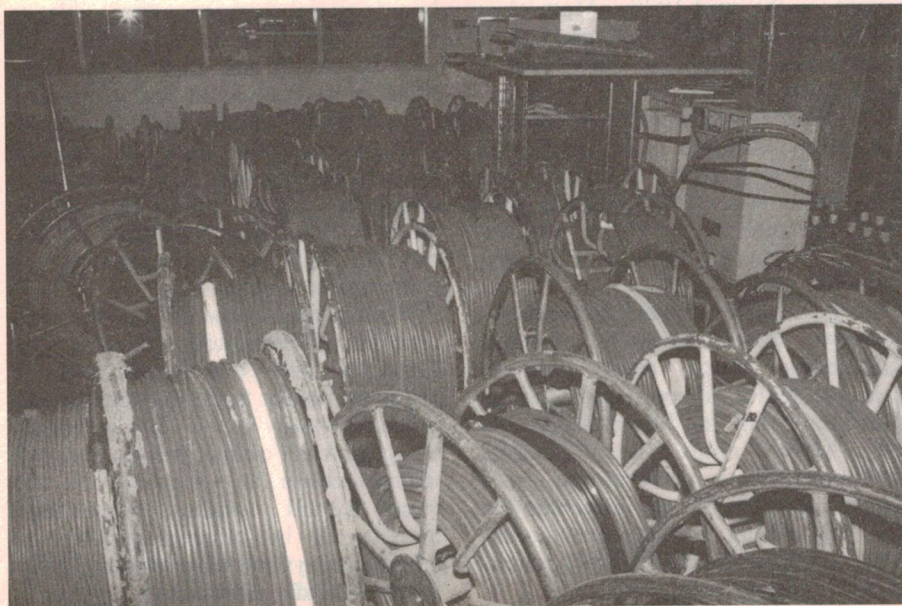
## Split in two

At about this time the camera design was cut in half, to reduce the bulk in the 'head' as the camera half became known. The signal was processed in the head only until it was robust enough to be passed down the cable, with remainder of the processing now done in a 'Camera Control Unit' or CCU.

While this greatly reduced the size of the head, it greatly increased the size of the cable. Now, as the power supplies were in the CCU, several wires were needed to carry the various voltages to the head, along with control wires to enable the remote adjustment of the video processing amplifiers that remained in the head, and synchronisation signals — which required more coaxial cables.

This move also created another job, that of the CCU operator — who controlled all the electronic parameters, such as levels, from a panel attached to the CCU. Now also included in the cable was program audio, cue lights and (via a motor and servo mechanism) control of the lens iris. As you can see, the camera cable was becoming a monster.

With the advent of colour, even more coaxial cables, twisted pairs and single wires had to be added, as there were now three video signals to control and



**Many reels of triaxial cable, in a TV station store room.**

**An old Marconi Mark 8 multicore connector (left) and a modern triax connector, on the 'OB West' connection panel of the Sydney Opera House.**

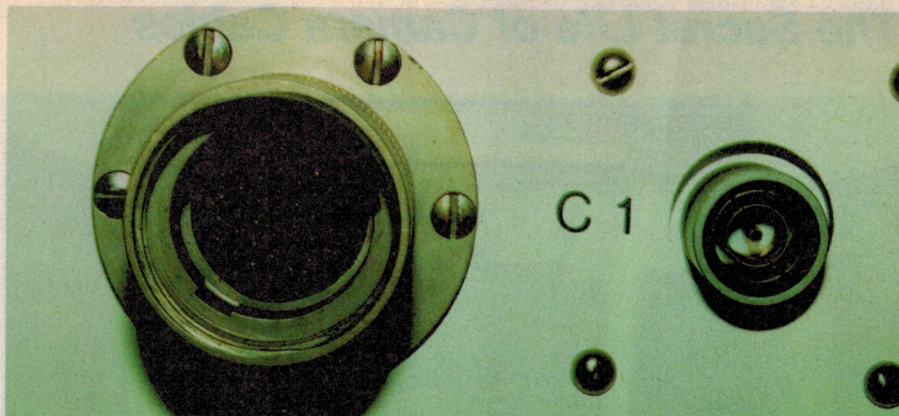
carry. To further complicate things, there was a push to reduce the size of the camera head still more, with the accompanying requirement for more remote control of head functions. Transistors and integrated circuits saved the day by providing a means of coding of the controlling signals for transmission down fewer wires.

Switch mode power supplies were developed to reduce the number of power wires required by making the various power supplies, now lower voltages, run from one supply from the CCU. Still, the camera cable of the 70's was a large and expensive item.

It had to be tough, too. The sheathing had to withstand dragging around the floor. And it had to protect the cores from damage caused by being walked on, run over by a camera pedestal or microphone boom, or any other form of physical torture imaginable. The overall diameter ended up at about 50mm.

While it was tough, it also had to be lightweight and flexible. Even so long lengths on steel drums, as used for outside broadcasts, frequently had to be handled with a forklift truck.

The connectors used at each end were highly specialised, having 50 or 60 pins. They were designed to support the heavy weight of the cable and yet be quickly connected and disconnected; to protect the terminations from rain; and to be tough enough to withstand the



rigours of outside use. The connector was locked into the socket on the camera using a screw or bayonet cover. This all added up to big dollars.

Reterminating multicore cables became an industry in itself.

The advent of the charge coupled device (CCD) to replace the thermionic camera pickup tubes meant that high voltages were not required in the head any longer, and our old mate the microprocessor and large scale integration at last made a new approach feasible.

### The Triax era

So this brings us to today. While we still have the multicore cable, the type most commonly used — almost universally on outside broadcasts — is the triaxial cable, or 'triax' to its mates.

Triax, I hear you cry — what's triax? Well, stay with me.

Triax cable is simply a coaxial cable with an extra shield. The outer shield is insulated from the inner shield, which

naturally is insulated from the inner conductor. Then the whole thing is protected with an outer sheath, which incidentally is always red in colour.

The complete cable varies in diameter from 8mm to 16mm, the larger diameters being able to operate over longer distances, due to lower high frequency losses. The connectors are reduced to a device that looks like a giant RCA connector. This Fischer brand connector has become a standard, and is used by all manufacturers, so a triax cable can be used on any brand of camera almost anywhere in the world. Naturally the Americans use a different connector, but it is largely confined to their country. They do this sort of thing because they are American.

Because of the greatly reduced cable weight, devices to lock the connector into the socket are often not required any more, although the design does allow for a locking mechanism.

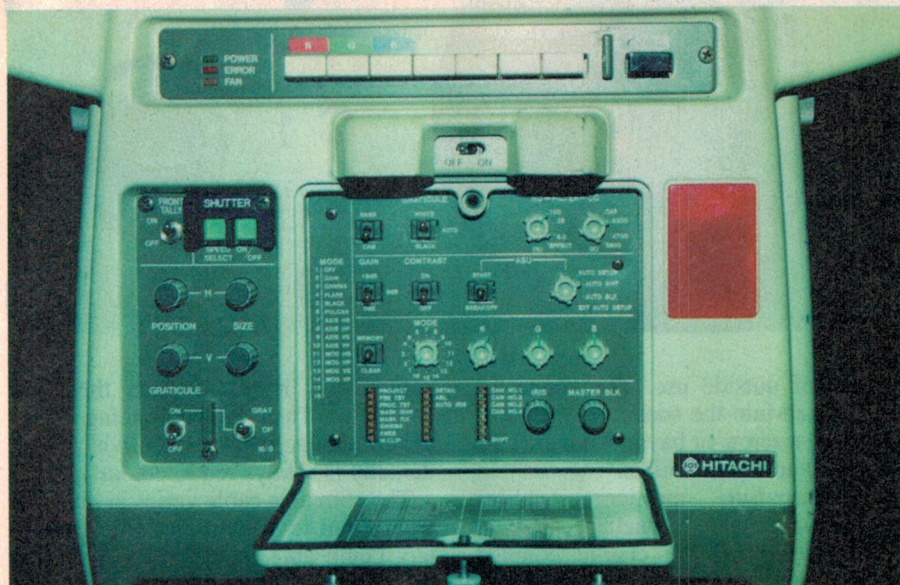
There are however both male and



**Left: An operator control panel. This panel is used by the Technical Director or Camera Control Unit operator to control an individual head. the large black control at the bottom right operates the iris when moved forward and back, the black level when turned, and the switching of the camera output to the preview monitor when pressed.**

**Above: A Camera set-up control panel. This panel is used to initially set up the camera, and can then be used to control iris and colour matching etc. It can be switched to a number of heads. It retains the camera setups and they can be reloaded into the heads.**

## The Secret Life of Camera Cables



**The camerahead control panel. This is used if the camera is operated without a CCU. Switching of the 'Mode' control allows many functions to be adjusted using the 'R', 'G' and 'B' knobs. The red panel is the Tally light. The upper row of switches controls the viewfinder.**

female versions of triax connectors, which look similar. This has led to a large number of death threats issued by OB supervisors against their cable runners. These nasty incidents arise when the supervisor tries to connect a camera, and discovers that the camera has a female socket on it and he has the female end of the cable in his hand. Meanwhile, two kilometres away, his assistant is about to attempt connect the male cable end to the male input of the OB van...

## 30 down to two

Eagle eyed readers will have noticed that the introduction of triax reduced the number of available circuits from 30 or so down to three — which turns out to be only two, because although the two shields are separate in the cable, they are connected together by the camera head. So how do all the various signals and power travel between the head and the CCU?

Simple. They are modulated onto FM carriers and sent along the cable all mixed up, and then retrieved at the other end by filters and demodulators. That's how.

Let's look in detail at how this works. Fig.1 shows the frequency spectrum of a typical system, in this case an Hitachi camera.

Starting at the left hand end, the low-

est frequency is 50Hz; this is 300V at about one amp, supplied from a 240 to 300 volt transformer in the CCU. At the head end of the cable there is a similar transformer, one winding of which is used to power a switch-mode supply to provide the head DC voltages, while another provides 240 volts AC for such accessories as an Autocue monitor.

The first real carrier is at 600kHz. Onto this is modulated the data from the CCU microprocessor, to control the various head functions. These include the lens iris and the cue lights, the red warning lights used by the talent and cameraman. These are actuated by a relay in the vision mixer, indicating that the camera is being used 'on air'. The microprocessor data can also switch test signals into the video paths in the head, for maintenance purposes.

Second we have video data, on a 950kHz carrier. This data is used to make the sync signals for the head.

Third comes the first of the intercom audio signals. This is engineering talkback to the camera operator. Engineering talkback is a switched talkback, that is you must 'press to talk'. It is used by the technical director or maintenance technician. The carrier frequency is 1.4MHz.

Fourth is production talkback. This is a continuous talkback to the camera operator from the director. It is on a 1.9MHz carrier.

Next, the fifth carrier on 2.45MHz is engineering talkback from the camera operator to the technical director or technician.

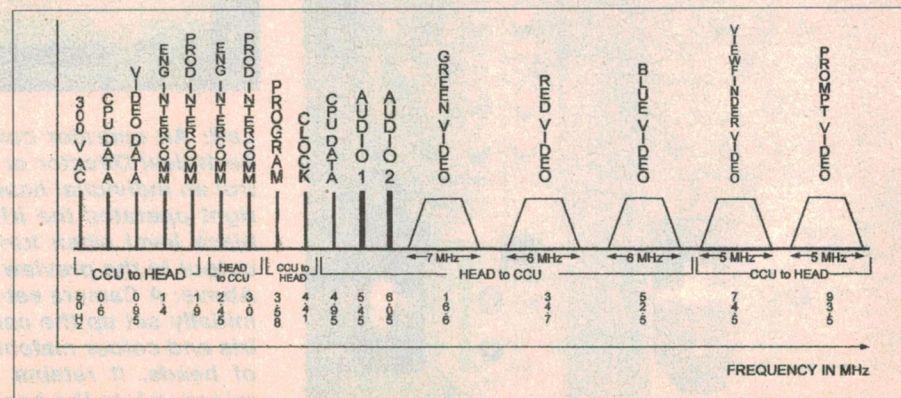
Then on 3.0MHz is production talk-back from the camera operator to the director. This is not used much, as is rare to be able to get a word in edgewise with most directors...

The seventh carrier is 3.58MHz, modulated with program audio. This enables the camera operator to keep track of the progress of the program, especially during recorded inserts, etc.

Next is the system clock. The frequency of this is 4.09MHz if the camera is being used in an NTSC system, or 4.41MHz if it is PAL. This is not a modulated carrier, but the actual clock frequency. It is combined with the video data, carrier two, to make the sync, vertical drive and horizontal drive signals.

Microprocessor data from the head to the CCU is next, on 4.95MHz. This provides acknowledgment of changes caused by data sent to the head, and also provides indicators of head conditions such as test set-ups and the iris setting, which is displayed numerically on the CCU panel.

Carriers 10 and 11 are two broadcast quality audio channels fed from microphone preamps in the head. These are especially useful in outside broadcast situations, where effects microphones



**Fig.1: The triax cable carries many different signals, virtually all as frequency modulation on RF subcarriers.**

are located on or near the camera. These carriers are on 5.45 and 6.05MHz.

The preceding 12 channels, if you include the mains 50Hz, are all of narrow bandwidth having an FM deviation of zero (in the case of the power and clock) to 100kHz for the audio channels. The next five video channels, though, are much wider.

The 13th channel is the green video from the head to the CCU. This is 7MHz wide, the widest of the video channels.

The 14th and 15th carriers are the red and blue video channels respectively. These are slightly narrower than the green at 6 MHz. each.

The last two carriers, at 74.5MHz and 93.5MHz, are the viewfinder video and the prompter or autocue video. These are black and white composite video signals. Composite means that vertical and horizontal sync pulses have been added to the video. These are 5MHz wide.

There is one other signal that is not shown in Fig.1. This is a 24 volts DC, which I suppose should appear at 0Hz. More about it later.

As can be imagined, the frequencies of the 16 carriers have been carefully worked out so that there is the minimum amount of interference between them. This of course has to include the sidebands at any modulation level — no mean task.

There is also the problem of attenuation in the triax. As this is higher at the upper end of the spectrum, the carriers are arranged so that the least essential functions are at the highest frequencies. As the

**The triax connector on an Hitachi SK-F700 camera. Also visible is the AC mains outlet.**



prompt video is the highest, on very long cable lengths this signal may not be useable. As an example, if 13.2mm triax is used, the maximum length is 1200 metres if the prompt video is required, or 1500 metres if it is not.

Incidentally, the maximum distance using the largest triax (16.2mm diameter) is 2.6km. As the system uses frequency modulation, attenuation does not cause problems until the signal is too small to be properly processed.

## How it's done

So this is the idea. Now let's see how it's done. Looking at Fig.2, the CCU end, the various input signals are applied to the modulators, and then to a bandpass filter. According to frequency, groups of modulated carriers are combined through bandpass, highpass or lowpass filters, and

finally placed onto the centre conductor of the triax. After coming through the same high and lowpass filters, the incoming carriers from the head are applied to their own bandpass filters and then to demodulators, which then output the baseband audio or data signals.

The incoming video carriers are treated slightly differently, with their own lowpass filter, and an AGC system using a variable attenuator to compensate for cable losses. The last thing onto the cable is the 300 volts AC and the 24 volts DC, via their own high power high pass filter.

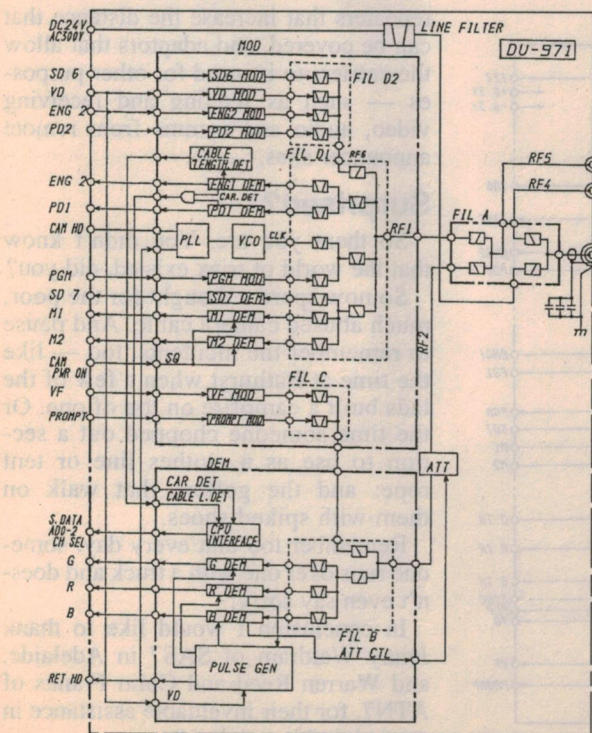
The situation at the camera head end (Fig.3) is much the same. The 300V AC and 24V DC are extracted first, again through their own high power highpass filter. Then the audio and data are demodulated via bandpass filters. The clock does not need a demodulator as it was not modulated in the first place, so it just has an amplifier.

The incoming viewfinder and prompt video carriers travel through another lowpass filter branching from the outgoing RGB video lowpass, and also have video lowpass filters in their outputs to remove interference artefacts. The audio, comms and data signals going to the CCU are modulated onto their carriers, filtered and combined onto the cable, as was done in the CCU.

## Safety risk?

The eagle-eyed reader referred to earlier may also notice that there is a potential problem of safety, in that one can have a large connector laying about in puddles of water with 300 volts on its centre pin.

Fortunately the designers are ahead of you. They have cleverly included two interlocks which must be in place before the 300 volts is applied to the cable. First, the inner and outer shield must be connected together; and second, the two talk-back channels from the head, engineering



**Fig.2: A block diagram of the circuitry at the CCU end of a triaxial cable system. The triax cable connector is at far left.**

# The Secret Life of Camera Cables

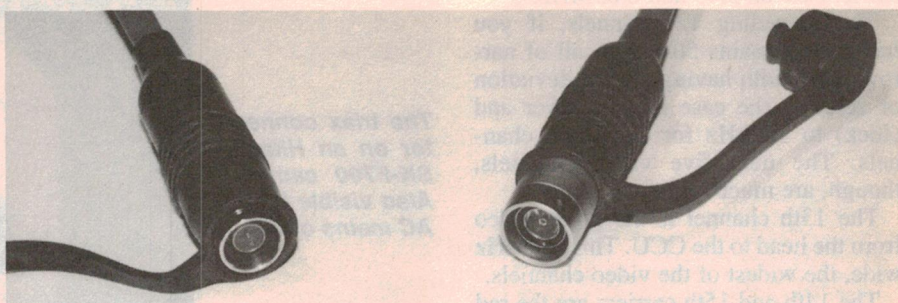
(ENG1 on 2.45MHz) and production (PD1 on 3.0MHz) must be detected by the microprocessor in the CCU.

But this presents another problem: how do you get the carriers up if there is no 300 volts in the head to power them in the first place? This is where the 24V DC comes in. It is sent up the cable when the CCU has detected that the shields are shorted, indicating that the head has been plugged into the far end of the cable. (In fact the shields are really connected together with a low value resistor rather than a short circuit).

The 24 volts starts up the comms section of the camera head, and the two carriers appear and are detected at the CCU end. This information is passed onto the controlling microprocessor and the 300V is enabled. The camera can now be switched on. Once the camera power supply is running the comms circuitry is no longer powered from the CCU's 24V, but is transferred to the main head supply. The 300V supply is also protected with circuit breakers and fuses in case of a short circuit occurring on the triax.

The fact that the comms can be run independently of the main supply is very useful during maintenance procedures, as it allows technicians at the CCU and at the head to communicate even if the head is turned off and has some boards removed.

But there is even more to the 'two carriers' requirement. It is not only to pro-



Male (left) and female Triaxial connectors.

tect the errant dog who finds a triax connector under his toilet tree, but also to protect the camera and CCU.

You see, in the days of multicore cables, every manufacturer used a different connector — so it was not possible to damage a camera by plugging the wrong head into the wrong CCU. But now, as all brands of cameras use the same connector, it is too easy to rush up with an Ikegami camera and plug it into an Hitachi CCU, in the heat of the moment on a busy OB. But since the carrier frequencies are different for each brand, the two comms carriers will not be detected and the camera will not switch on; so the day is saved.

The ENG1 carrier is also used to estimate the length of the triax, by measuring the carrier level. This information is passed onto the microprocessor and is used for equalisation settings.

There are a number of other features

in most triax systems that are interesting. It is possible to run them on normal coax cable, such as RG-59, usually at reduced cable length, although RG-11 can do a respectable 1220 metres without prompt video. The noise immunity of coax is naturally not as good as triax, but it is cheaper.

It is also possible to run the head self contained — that is, without a CCU at all. In this mode the head is powered locally from 12 volts, and is operated using the inbuilt control panel. An adaptor box which is connected to it with a short triax provides a video output suitable for a microwave link. The reverse link can supply viewfinder or prompt video, and the link's audio channels can be used for comms.

Fibre optic cable can also be used, but again, as there are usually no physical wires with an optic cable, power must be supplied locally.

Accessories are available such as repeaters that increase the distance that can be covered, and adaptors that allow the carriers to be used for other purposes — such as sending and receiving video, audio and comms from remote announcer sites.

## Surprised?

So there you are. You didn't know that the world of triax existed, did you?

So now spare a thought for the poor, much abused camera cable. And pause to remember the incidents, too — like the time at Bathurst when a few of the lads built a campfire on top of one. Or the time someone chopped out a section to use as a clothes line or tent rope; and the golfers that walk on them with spiked shoes.

Remember too that every day, someone runs over one with a truck and doesn't even say sorry!

In conclusion I would like to thank Jenny Waldram of SAS7 in Adelaide, and Warren Reed and Colin Franks of ATN7, for their invaluable assistance in preparing this article. ♦

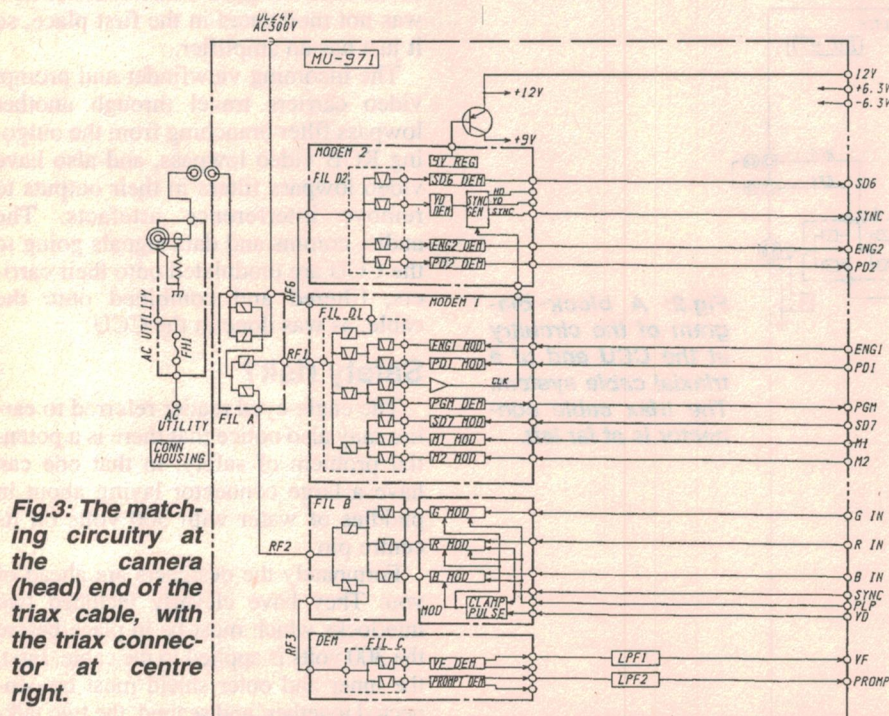


Fig.3: The matching circuitry at the camera (head) end of the triax cable, with the triax connector at centre right.

# New Year Stock Clearance

## Transistors and IC's - Transistors and IC's

		Normally	January			Normally	January
2N2905	PNP 60V 600ma	\$1.20	\$0.60	BD140	PNP 80V 1A	\$1.25	\$0.60
2N3055	NPN 60V 15A TO3	\$3.50	\$2.00	BU326	NPN 800V 6A	\$7.95	\$5.95
2SC1923	NPN 40V 20mA RF	\$1.50	\$0.75	LM555	Timer IC	\$1.20	\$0.60
2SD350A	NPN 1500V 5A	\$19.95	\$8.95	LM741	OP AMP	\$1.20	\$0.60
BC327	PNP 45V 800mA	\$0.35	\$0.18	MAX232	RS232 Tx/Rx	\$9.95	\$6.95
BC337	NPN 45V 800mA	\$0.45	\$0.18	MJ15025	250V 16A PNP	\$12.95	\$6.95
BC546	NPN 65V 100mA	\$0.25	\$0.10	MJ2955	PNP 60V 15A	\$3.50	\$1.50
BC547B	NPN 45V 100mA	\$0.25	\$0.10	MJE 13007	NPN 400V 4A	\$6.95	\$3.50
BC548B	NPN 30V 100mA	\$0.25	\$0.10	MJE2955T	PNP 60V 10A	\$2.95	\$1.50
BC549B	NPN 30V 100mA	\$0.25	\$0.10	MJE340	NPN 300V 500mA	\$2.95	\$1.50
BC550C	NPN 45V 100mA	\$0.75	\$0.30	MJE350	PNP 300V 500mA	\$2.95	\$1.50
BC 557B	PNP 45v 100mA	\$0.25	\$0.10	TIP122	NPN 100V 5A	\$2.95	\$1.50
BC558B	PNP 45V 100mA	\$0.25	\$0.10	TIP127	PNP 100V 5A	\$2.95	\$1.50
BC559B	PNP 45V 100mA	\$0.25	\$0.10	TIP2955	PNP 100V 5A	\$2.95	\$1.50
BC639	NPN 80V 1A	\$0.95	\$0.40	TIP31c	NPN 100V 3A	\$1.95	\$1.00
BC640	PNP 80V 1A	\$0.95	\$0.40	TIP32C	PNP 100V 3A	\$1.95	\$1.00
BD139	NPN 80V 1A	\$1.25	\$0.60	TIP41C	NPN 100V 6A	\$2.50	\$1.20
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# NEVILLE WILLIAMS: WRITER, EDITOR & MENTOR

His name has been so closely associated with this magazine, for so many years, that it's hard to grasp that the man himself is suddenly no longer with us. Yet in the 55 years that he worked on the magazine, he rarely allowed himself to step into the spotlight. Almost always, his satisfaction came from quietly helping both his colleagues and readers *understand* about the many and changing facets of electronics. Here then is our tribute to the man himself — magazine editor, technical writer and author, educator, project designer and radio amateur, and pillar of his church.

Walter Neville Williams was born on 17th August, 1915 in Orange, NSW. In the early 1920's his parents moved the family to the tiny village of Bargo, in the southern highlands region of NSW (about 70km south-west of Sydney). It was here that young Neville (he preferred his second name) grew up, on a typical rural farmlet.

Although nowadays Bargo is barely an hour's drive from Sydney, in those days it was very much a remote rural community. Until the arrival of radio broadcasting, virtually the only links with the 'big smoke' were the steam trains which passed nearby, on the main southern railway.

About the only contact that young Neville had with anything technical was via his maternal grandfather Alma ('Alf') Hicks, who ran the local motor garage and workshop. The inventive Mr Hicks had also built a community hall-cum-silent picture show, complete with a DC electric lighting plant whose batteries were charged via a stationary petrol engine, and this electricity supply had been extended to neighbouring shops and homes.

As Neville himself wrote, 'Pa' Hicks became a role model for his mechanically-minded grandson, encouraging him to take an interest in matters technical and showing him that understanding and solving technical problems could be both challenging and satisfying.

Later he recalled that another key event in his young life, with relevance to his later career, was in the 1920's when his parents bought their first 'wireless set'. It was a four valve Colmovox, like most other receivers of the period operated from large and smelly batteries.

When the time came to move on from the local primary school, Neville was enrolled at Parramatta High School and began five years of commuting back and forth every schoolday by steam train. It was a long and tedious trip, but now and

again a little innocent 'skylarking' made the time pass faster — like fitting a half-penny coin under one of the low voltage light bulbs in the train carriage, so it would blow the fuse when someone tried to switch on the lights at dusk...

Of course there were also plenty of opportunities to complete homework and catch up on reading. The end result was that he did well in his studies, was appointed a school prefect in his final year, and graduated at the end of 1932 with a good Leaving Certificate and some glowing character references.

At Parramatta High, thanks to the enthusiasm of one of his teachers, his interest in wireless had been rekindled during the final year. Under the guidance of Mr Baldock he built his very own crystal set, and was 'bitten by the radio bug'.

Once the Leaving Certificate was behind him, it was therefore understandable that Neville was keen to find a job in the radio industry. And his wish was soon granted, when in 1933 he was accepted for a position at Reliance Radio, a small but dynamic manufacturer of radio receivers located in Barrack Street, in Sydney. Initially he was a 'junior wirer', but his initiative and thirst for knowledge soon resulted in rapid promotion to the test bench as a senior technician, and he gained a great deal of experience in receiver production, testing and servicing. Work on the top-of-the-range 'York' receiver also began to develop in him an interest in high quality audio reproduction.

Soon after Neville had begun working at Reliance, his family moved to the Sydney suburb of Guildford, and established strong links with the Baptist churches at Guildford and Merrylands. Thus began Neville's own deep involvement with the Merrylands Baptist Church, which covered well over 40 years and included roles as deacon, organist, Sunday School Superintendent

and Family Night organiser.

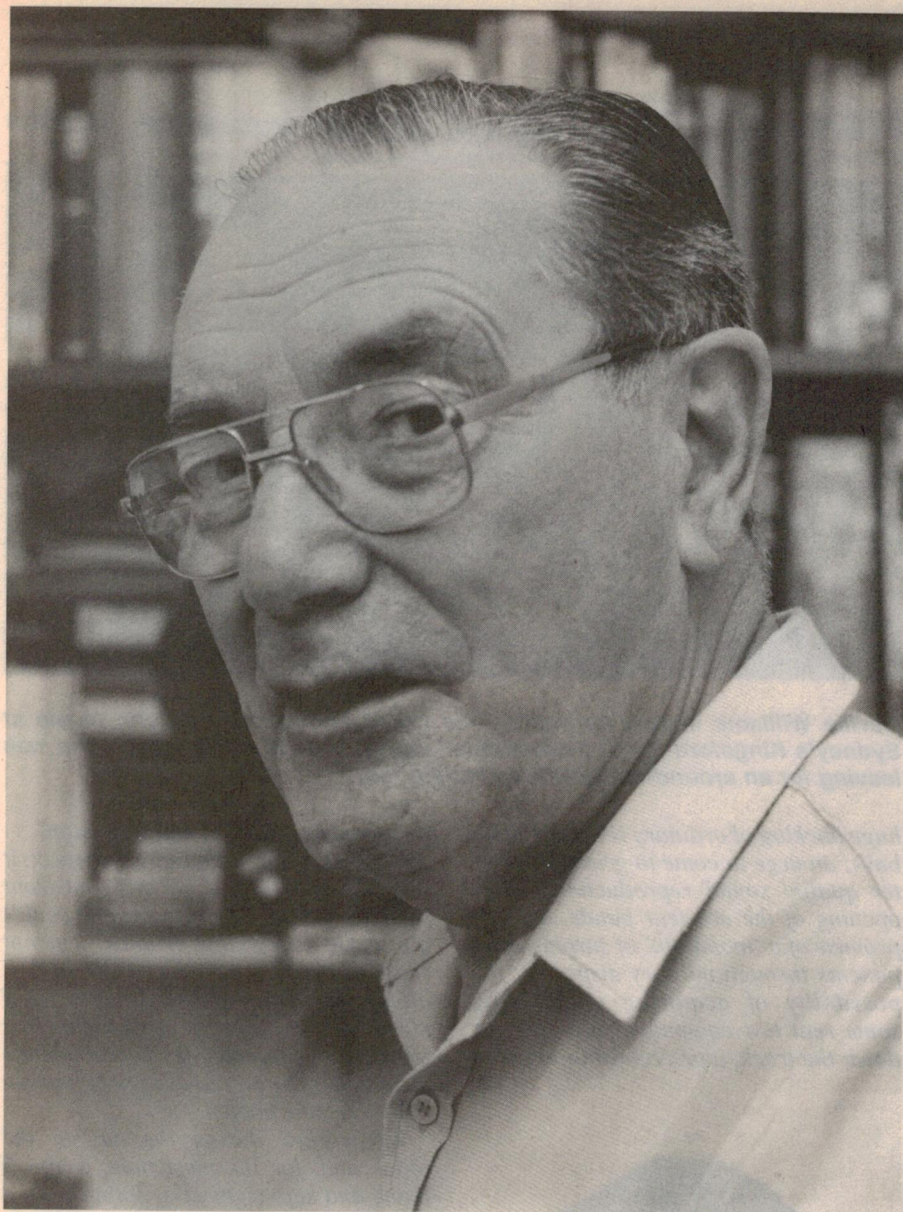
Late in 1935, Reliance Radio had a difficult technical problem with the then-new 6L6 output valves. A call to valve supplier AWW (the Amalgamated Wireless Valve Company, an AWA offshoot) resulted in that company's chief applications engineer Fritz Langford-Smith ('FLS') paying them a visit, to see the problem for himself and offer his expert advice.

The interest and enthusiasm of young Neville Williams must have caught the attention of Langford-Smith, because before long (in 1936) he was invited by FLS to join the staff of AWW's valve applications laboratory, at the AWA works in Ashfield. Both there, and later at the AWW lab in AWA's head office building in York Street as Langford-Smith's personal assistant, he acquired a deep and comprehensive knowledge of thermionic valves and their operation.

Valve technology was progressing in leaps and bounds at this time, and Neville was working with one of the acknowledged pioneers. The team produced valve data sheets to guide designers, and also *Radiotronics*, a monthly technical bulletin giving detailed valve applications data.

In 1938, during this time at AWW, Neville and his sweetheart Min Henderson were married. After a short time in a rented cottage, they moved into and began buying a house in Manchester Street, Merrylands. Here they made a home for many years, and raised two children — Greg and Jenny.

In the AWW applications lab Neville found himself drawing many of the circuits and graphs for *Radiotronics*, and also became deeply involved in the production of the much-expanded third edition of the *Radiotron Designer's Handbook* (published in 1940), which like its successor the fourth edition (1952) was to become famous and reprinted around the



**Neville Williams as many of us will remember him. This picture was taken early in his retirement, as he worked on an article for the magazine.**

world. Nowadays the *RDH* is regarded as an undoubted 'classic' among electronics reference books.

In 1939, Neville was asked by FLS to prepare and present a series of six technical lectures for radio servicemen. These were very well received, and were subsequently published as booklets. He also gave some lectures to students of the Marconi School of Wireless. In 1940 he prepared and presented a course of five lectures to signals trainees of the Australian Army's Eighth Division, based at Ingleburn in NSW. Then in 1941 he wrote some articles for the trade journal *ERDA*, on 'Multiband Superheterodyne Receivers', and also prepared a series of

theory articles for the new magazine *Radio & Hobbies*.

By this stage the name Neville Williams and the initials 'WNW' had quietly become known and respected among a wide circle of Australia's radio designers, service technicians and serious enthusiasts, for his clear technical writing and informative lectures.

### **In at the deep end!**

Largely as a result of the articles he produced for the fledgling *Radio & Hobbies*, Neville became friends with John Moyle, its then editor. Moyle himself had joined *Wireless Weekly*, the precursor of *R&H*, in 1932, and since then had built up a wide reputation as a

writer, editor, radio amateur, designer and builder of many very popular radio receivers, amplifiers and amateur radio transmitter designs.

Australia was by then involved in the War, and later in 1941, John Moyle decided to join the RAAF as a radar instructor. But he wanted the magazine to survive and flourish in the meantime, and immediately thought of his new friend Neville Williams. Would Neville be prepared to leave his secure position at AWW, to join the magazine — both as its Technical Editor, and also as Acting Editor for the duration of the War?

Neville recounted much later that he almost didn't accept the invitation, but after giving it considerable thought he finally did so. Thus in December 1941 he began his long 'official' career in technical journalism, although clearly he had already begun semi-officially at AWW.

It was very much a case of being 'thrown in at the deep end', though, because no sooner had he arrived at the *R&H* office in the Associated Newspapers building in Elizabeth Street, than John Moyle was shaking his hand, wishing him well and departing for the RAAF. Neville was left almost alone to 'mind the baby', until John Moyle returned at the end of the War — and with resources that were a far cry from the laboratory he'd worked in at AWW...

In an article he wrote for our April 1989 issue, he described the magazine's modest technical facilities at the time:

*We were very much on our own in the organisation, with a workbench, a soldering iron, a few hand tools and a steel cupboard containing an odd assortment of left-over wireless bits and pieces. By way of test equipment, the department boasted a Weston multimeter and a Paton modulated oscillator — the latter probably acquired following its review in the August 1939 issue. That was all!*

*What a contrast to the AWW lab, with its quality control equipment, its own array of individually calibrated reference meters in traditional polished wooden cases, and routine access to any amount of other equipment from elsewhere in the Ashfield complex...*

Apart from advertising manager 'Pop' Morse and editorial manager Jack Lillis, his only link with the magazine's immediate past was a young assistant, Charles Birchmeier. But they got stuck into it, between them producing a couple of projects (one a simple PA amplifier) and finally managed to finish the February 1942 issue and send it away for printing.

Much later, he noted that it was all rather different from what he'd been

## Neville Williams: Writer, Editor & Mentor

used to at the AWW lab, and the change of working 'climate' had not been easy. Even writing the leader or 'editorial' took a fair degree of adjustment, as he described:

*At AWW, I neither learned nor practised the art of writing an editorial. As with most other such companies, manuals were concerned strictly with unembellished facts — compiled by an anonymous writer for persons unknown.*

*Indeed, I later came to realise that a good magazine writer is the very antithesis of someone trained to compile technical manuals. An effective writer must do more than merely present facts; in the process, he or she must also motivate interest and communicate with the targetted readers.*

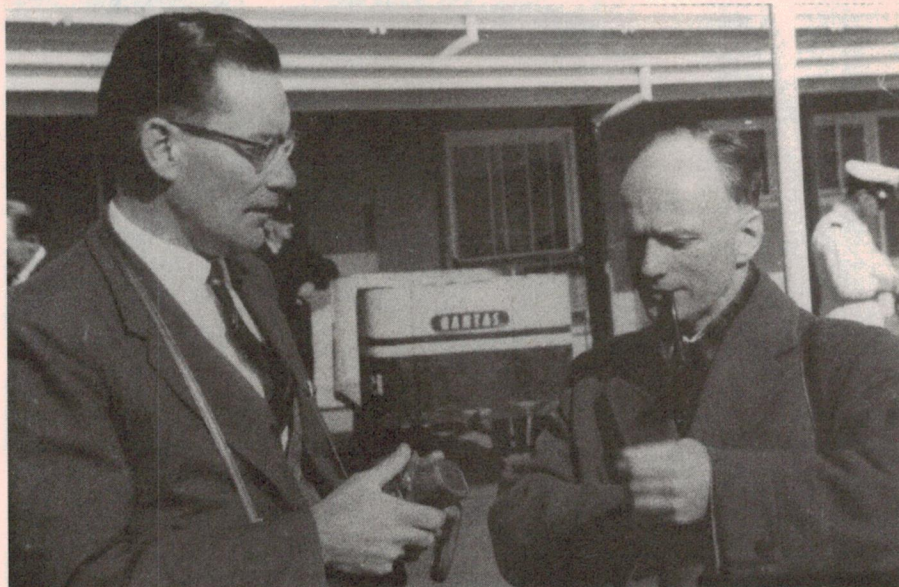
Jack Lillis told him his first leader read 'like a new year message from one of the local archbishops' — and as a result he replaced it with an advertisement. But he persevered for the next issue, mastering the style and from that point on never missing a leader until he passed on the editorial baton, many years later.

With only Birchmeier's assistance and the help of a shared typiste, Neville produced *Radio & Hobbies* every month for the next four years, until John Moyle's return. This involved not only designing, building and writing about a string of radio receivers, amplifiers and other equipment, but also all of the other jobs of a magazine editor: chasing up material from the regular contributors, sub-editing their articles, organising photography, laying out the articles and issues, proof reading and so on.

It was a huge workload, but also a great situation in which to learn and master new skills. By the time John Moyle returned, Neville Williams was an experienced and highly capable technical magazine writer and editor — as well as a very efficient and innovative designer/builder of radio and audio construction projects.

When John Moyle *did* return, though, the magazine really 'took off'. The circulation rose dramatically, largely as a result of their combined skills, interests and energies. The time was right, too, because wartime restrictions were lifted and there were also a huge number of people returning to 'civvy street', many of them keen to either renew their existing hobby involvement, or build upon new skills they had acquired in the armed forces.

As Neville wrote later, there was ...a



**Neville Williams shown farewelling his friend and colleague John Moyle at Sydney's Kingsford-Smith International airport, in 1956. At the time John was leaving for an around-the-world factfinding tour.**

*huge backlog of ordinary receivers to be built; an urge to come to grips with better quality sound reproduction; a re-opening of the amateur bands, and the promise of a 'mountain' of surplus components through military disposals; the possibility of acquiring or building some real test equipment; and, further down the track, tape recording, a vastly*

*improved disc format and television!*

*Far from being a daunting prospect, it was like a 'bunch of carrots' out front — exasperating only because one couldn't tackle everything at once. I'm not exaggerating to say that John and I, along with our newly recruited staff members, were like overgrown kids in a toyshop — incredulous that somebody was willing to pay us wages to pursue our collective hobby!*

*We worked during the day in the office and, for the most part, went off home and kept right at it. John set up a ham shack and workshop in a spare(?) bedroom where, amongst other things, he spent countless hours grinding and etching crystals. I had a desperately overcrowded 'shack' in the backyard. Hifi gear dominated our respective living rooms.*

Together they were extremely productive, and month after month the magazine presented a seemingly endless procession of innovative designs for DIY radio receivers, amplifiers, amateur radio gear, test instruments, and audio recorders — first of the disc variety, and later using magnetic tape. And as new technology appeared, they kept spurring each other onward, to both master it and present both articles and projects to help their readers do likewise.

When the Federal Government decided in 1955 that television broadcasting would begin in Australia in 1957, both Neville and John Moyle began reading



**One of the pictures which made Neville Williams instantly recognisable to countless 'Radio & Hobbies', 'R, TV & H' and 'Electronics Australia' readers, over his 55 years with the magazine.**

up on the technology and planning construction projects. In July 1955, Neville presented a lecture to the Sydney Division of the IRE entitled 'The Elements of Modern Television', which attracted a record attendance of members and visitors and was later nominated as one of the best lectures ever presented to the Division.

He also began writing a very popular series of theory articles entitled 'A Course in Television', the first chapter appearing in the September 1955 issue of the magazine (by now renamed *Radio, Television and Hobbies*).

As Neville recounted later, he and John soon became engaged in a 'two-horse race', to see who could develop the first working TV receiver design suitable for home construction. Their first approaches involved using 5" and 6" ex-radar tubes with green phosphors, and with circuitry involving a surprising number of disposals valves (they were very cheap). It was a while before either came up with complete receiver designs, but a collection of experimental circuit ideas appeared in the December 1956 issue, and a description of a VHF tuner appeared in the following March issue.

Neville himself came up with the first complete TV receiver design, a 17" model which appeared in the May-July 1957 issues. John followed hard on his heels with a complete 5" design, in the September-October issues. Both were developed before regular TV broadcasting began, that September — so both designers had to make do with test instruments and the sporadic signals broadcast by the first stations as they prepared for day-to-day operation.

Neville kept on developing and describing TV receivers for home construction, and they were extremely popular. His memorable 1959 design (August - October 1959) was capable of reception every bit as good as the best commercial models then available, and was built with great success by many hundreds of delighted readers.

This wonderfully productive partnership continued until the beginning of 1960, when John Moyle returned very ill from an overseas trip and was diagnosed with cancer. He died in hospital shortly after, and Neville found himself again running the magazine alone — this time as Editor.

Unfortunately he soon experienced a health trauma of his own — although luckily much less severe. As he related in 1988:

*While working on a project in my backyard 'shack', I hurried out into the damp and wintry night, slipped on*

*a wet concrete step and ended up with a broken femur. Next morning, my wife had to ring assistant editor Phil Watson with the news that I would be in traction for an indeterminate number of weeks, and that he'd have to be the new instant editor!*

*So while, for the next four months, I wrote and edited what I could, propped up on pillows, it fell to Phil to make the on-the-spot editorial decisions.*

Needless to say Neville was back at the office (and working in the backyard shack) as soon as he was able to do so

ties of all the necessary componentry: keyboard and pedalboard assemblies, oscillator and filter components, cabinets and so on. However just before full-scale manufacture was to begin, management decided that the project was too risky and decided to 'pull the plug'. This of course still left them with a dilemma: how to clear that large stock of organ components.

When Neville Williams heard of their plight, he immediately suggested a solution: How about letting him adapt the original design into an expandable DIY



**Taken at the testimonial dinner given in July 1983 to mark to mark his retirement, this picture shows Neville Williams being presented with a VZ-200 computer and word processor by Jim Rowe, on behalf of Dick Smith Electronics.**

— although initially with the aid of crutches, and then a stick. It took quite a while for the leg to fully recover, and for some time he walked with a slight limp.

Before long, though, he was deeply involved in developing a major new project: the Stromberg-Playmaster Electronic Organ, presented in the November 1961 - August 1962 issues.

Neville had always had a deep interest in organs and organ music, perhaps as a result of his involvement with the church. However until then building one's own organ (pipe or electronic) had been a project well beyond the reach of both magazine editors and their readers — and really only practical for a handful of 'serious' enthusiasts with well-equipped workshops and huge amounts of time and patience.

But in mid 1961, an opportunity arose. Local firm Stromberg-Carlson (A/sia) had planned to manufacture and market a small spinet-type electronic organ, and had bought in large quanti-

ties of all the necessary componentry: keyboard and pedalboard assemblies, oscillator and filter components, cabinets and so on. However just before full-scale manufacture was to begin, management decided that the project was too risky and decided to 'pull the plug'.

Needless to say Strombergs were delighted with the idea, and the rest is history. Stromberg-Playmaster organs were built in large numbers, and ended up providing music in homes, churches and clubs around Australia.

As time went on and technology kept on changing, the magazine inevitably had to keep adapting to the changing needs of its readers. Calmly and carefully, Neville saw to it that the correct changes were made. With the April 1965 issue its name was changed to *Electronics Australia*, and leading by example he encouraged each staff member to keep both themselves, the magazine and its readers abreast of developments. We were all kept busy learning in turn about transistors, integrated circuits, digital logic and computer technology.

None of this was done in an imperious manner — that wasn't Neville's style at

## Neville Williams: Writer, Editor & Mentor



A photo of Neville taken at the same session as the one we used in the heading for his very popular 'When I Think Back' column.

all. His was more the 'softly, softly' approach: drawing your attention to interesting new articles and papers, encouraging you to follow your natural curiosity and enthusiasms, quietly helping you with advice and suggestions if you struck difficulties, and gently complimenting you if and when it all turned out well.

Of course the magazine's staff gradually changed over the years, with some people moving on and new people joining. But throughout it all Neville Williams remained calmly at the helm. Along the way he became Editor in Chief, as *EA* spawned other titles: first the short-lived *Modern World*, then *Electronics News* (now part of Reed Business Press), and later *Video Mag*.

Eventually, though, it was time to retire from full-time work on the magazine. On July 27, 1993 he was given a big retirement/testimonial dinner, hosted by then Editor Leo Simpson and Mr John B. Fairfax — Chairman of the Board of the magazine's then publisher, Magazine Promotions. (Mr Fairfax is nowadays still associated with the magazine, as co-proprietor of Federal Publishing and its parent company General Newspapers.) The dinner was attended by a great many people from the industry as well as current and former staff members and contributors, and showed the enormous regard in which he was held by all.

Needless to say, though, after so many years of involvement with the magazine Neville couldn't simply stop and 'take up fishing'. One of his retirement gifts was a small computer and word processor, which he immediately proceeded to put to use as a regular freelance contributor. As well as continuing to conduct his long-running 'Forum' discussion column (which he had began back in September 1950, as 'Let's Buy and Argument'), he also kept turning out a steady stream of articles on hifi topics, theory and new developments in video technology.

In February 1989, soon after the 'Forum' baton had been passed to myself, he began writing a series of articles on early technology and those who developed it — the 'When I Think Back' series, which generated a great deal of interest among readers of all ages. His WITB articles continued with very few breaks until last month's instalment, and like many of his previous articles some were turned into a very successful book: *Australia's Radio Pioneers* (Federal Publishing, 1994).

Among the other books that he had written, either solely or jointly over the years were *Basic Electronics* (which sold well over 50,000 copies) and *HI-FI: An Introduction* (Federal Publishing, 1991 and 1994), which sold over 30,000 copies. As technical books go, in the Australian market, they were all undoubtedly 'best sellers' and helped huge num-

bers of readers understand the basic technology of electronics and hi-fi.

### Illness strikes

Apart from the broken leg in 1960, Neville had always enjoyed very good health. However in September 1994, he somehow contracted a very serious illness — the cyto-megalo virus or 'CMV', which causes one's red blood cells to self-destruct. Twice he almost died, but after many blood transfusions and a lot of effort by the medical staff at Sydney's Royal North Shore Hospital, he pulled through and began a long but steady recovery. Together with his family and many friends he was very grateful for what they described as "the gift of extra time".

But sadly the gift was all too brief. The bout with CMV had left him very weak physically, and with serious ongoing complications. Then a couple of months ago he was unlucky enough to fall again, breaking his leg in almost the same place as in 1960. There were further complications, and finally it was more than even his impressive personal resources could handle. He passed away quietly in Sydney's Westmead Hospital on November 7, 1996, at the age of 81.

No one's life can be adequately described in a few brief pages, but hopefully the foregoing may have given you at least an impression of the life and many achievements of this widely respected man. Needless to say his role as an electronics editor and writer — daunting though it was, spanning an incredible 55 years — was really only one facet of his rich personality. To his wife and family he was a devoted and loving spouse, a wise and helpful father and much loved grandfather; and to his wide circle of friends in the Baptist Church, an unassuming but inspiring and hard-working pillar of practical faith.

To those of us who have had the privilege of working for and with him on the magazine, he was also an understanding 'boss' and a very supportive colleague. Above all, to many of us he was also a true mentor, not just in the technical sense but personally as well.

Farewell, Neville. We're really going to miss you — not just the magazine and its staff, but the countless readers whom you've helped so much over those 55 years.

My grateful thanks to Neville's daughter Jenny and his brother Elwyn Williams, for their generous assistance in the preparation of this article. (J.R.) ♦

# SHORTWAVE LISTENING

with Arthur Cushen, MBE

## VOA to build new Pacific relay base

Construction has commenced in the Northern Mariana Islands of a new relay base for the Voice of America, and this should be completed by December 1998. The Northern Mariana Islands are already well known to shortwave listeners, as Saipan has two shortwave services; but the VOA transmitters are to be located on Tinian in the same group.

There will be three 500kW transmitters, which were formerly used by Radio Liberty and Radio Free Europe at a site in Portugal. These are to be moved to Tinian, which will also have an extensive aerial array.

The new site will carry broadcasts to China and Indonesia in English, Cantonese and Indonesian, and will serve other parts of Asia in Burmese and other Asian languages. The cost of the installation is put at \$15 million and the site will contain a transmitter building, a power plant, and an administration block. The station will also be used by a new organisation, Radio Free Asia, which was formerly known as the Asian Pacific Network.

Saipan is the site of KFBS and KHBI, while the nearby island of Tinian is one of the three larger islands of the Mariana group. It's also one of the southernmost, and is 650km north of Guam.

The new location for the VOA relay base

will strengthen the VOA signal from the Pacific, which is now dependant on the transmitters in the Philippines.

## Radio Free Asia

The launch of Radio Free Asia, with broadcasts directed to East Asia had an interesting twist, as in the opening announcement the station did not disclose the frequencies or the location of the transmitters in fear of Chinese jamming. However international broadcasters soon disclosed the channels for the two daily broadcasts in Chinese, at 1500-1600 and 2300-2400UTC.

The transmitters used are mainly in the former Soviet Union and as well, KHBI Saipan is carrying the service on one frequency.

The early Chinese transmissions were heard in this area at 1500UTC on 7495kHz, with English announcements at the opening, closing and on the half hour. The announcement was 'This is Radio Free Asia, the following programme is in Chinese'. New studios in Washington are being built and by February the transmissions should be carried in seven languages.

Radio Free Asia is funded by the US Senate and is separate from the Voice of America.

The frequency list and locations released by Media Network on Radio Nederland shows broadcasts as follows: in Chinese at 1500UTC

on 5865kHz and 7495kHz from Kazakhstan; on 7530kHz from Armenia; on 6205kHz and 6240kHz from Kyrgyzstan; and on 9455kHz from Saipan KHBI. At 2300UTC, on 7495kHz from Kazakhstan; on 7430kHz from Armenia; on 6205 and 6240kHz from Kyrgyzstan and on 13,825kHz from Saipan.

The later broadcasts which are to be carried are KHBI Saipan in Korean at 2200 on 13,825kHz; and Laos at 0100 on 13,625kHz. Further broadcasts are scheduled to Tibet, Burma and Vietnam.

## South Africa expands

In 1966 Radio South Africa commenced operation with four 500kW transmitters, but in recent years the service has been downgraded and is now known as Channel Africa. At the same time, there has been leasing of transmitter time to various organisations wishing to be programmed to Southern Africa. The latest installation is four 100kW transmitters for the BBC at the transmitter site at Meyerton, south of Johannesburg.

The BBC has closed its transmitting facilities at Lancers Gap, Lesotho and the frequencies have been taken up by the Meyerton transmitters. The schedule is 0600-0800 on 6125kHz; 0800-1200 on 11,900kHz; and 1500-0600 on 3280kHz. Further expansions of this site are planned, as it is also being used by Trans World Radio and the Voice of America.

Broadcasting is now under Sentech, the common carrier for broadcasting in South Africa, and their address is: Private Bag X06, Honeydew, 2040 South Africa. At the present time Channel Africa is broadcasting in English, French and Portuguese, all commencing at 0500UTC. They are on 9675kHz, 9525 and 7185kHz and the full transmissions are 0500-0555. ♦

## AROUND THE WORLD

**KUWAIT:** Radio Kuwait's broadcasts in English, taken from the latest schedule are 1800-2100 on 11,990kHz, with news at 1830 daily except Thursday. The schedule shows transmission to Europe and North America 0000-0530 on 11,675kHz; 0930-1605 on 13,620kHz; 1615-1800 on 11,990kHz; 1745-2300 on 15,505kHz; 1800-0000 on 9855kHz and 1800-2100UTC on 11,990kHz.

**LEBANON:** Radio Lebanon has had approval to upgrade its facilities to the extent of US\$33 million. Continental Electronic has been selected to do the work, which includes new buildings and the installation of six new short-wave AM and FM transmitters. The Government of Lebanon has also restricted the number of shortwave transmitters, and the Voice of Lebanon on 6550kHz which has operated for several years is faced with closure.

Another signal from Lebanon, though actually in the Israeli controlled section, is Wings of Hope. Broadcasts in English are 1600-2100 on 6280kHz; and 1300-1330 and 1700-1730 on 9960kHz. The balance of the broadcasts are in East European languages. The powers of the transmitters are 10kW for 6280kHz and 25kW for 9965kHz.

**NEDERLAND:** The latest schedule for Radio Nederland, at Hilversum, shows 0730-0830 on 11,895kHz; 0730-1030 on 9830kHz; and 0930-1130 on 12,065 and 13,710kHz. The frequencies of 9830kHz and 11,895kHz are from Bonaire, while 12,065kHz is from Petro Kam and 13,710kHz comes from Irkutsk.

**PALAU:** The Republic of Palau, KHBN Koror on 9965kHz is heard with English at weekends 0730-1130 and 1400-1430, with all other transmissions in Mandarin. Weekdays 0730-1100 is in Korean and Vietnamese, while the schedule shows the additional frequency of 9730kHz. The power of the transmitters is 100kW for 9965kHz and 50kW for 9730kHz.

**PHILIPPINES:** FEBC Manila broadcasts in English 0930-1100 on 11,635kHz; 1300-1600 on 11,995kHz and 0100-0300 on 15,450kHz.

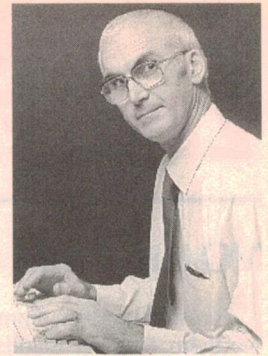
**POLAND:** Polish Radio, Warsaw broadcasts in English 1200-1255 on 6095kHz, 7145, 7270, 9525 and 11,815kHz; 1700-1755 on 6095kHz, 7270 and 7285kHz; and 1930-2025 on 6035kHz, 6095 and 7285kHz. This latter frequency gives the best reception.

**UNITED KINGDOM:** The BBC World Service is to transmit in English in three streams instead of five. The World Service is to drop its historic frequency of 15,070kHz, which has been used for many years with the call-sign of GWC, as they move into the allocated shortwave bands.

**USA:** KVOH Los Angeles transmits 0100-0600 in English on 9975kHz with a 80kW transmitter; 1500-0000 on 17,775kHz in Spanish and 0000-0100 on 9975kHz, also in Spanish.

The schedule for WWCR, Nashville on the lower frequencies is 0200-1000 on 2390kHz; 0500-1000 on 3210kHz; and 2300-1100UTC on 5065kHz. ♦

*This item was contributed by Arthur Cushen, 212 Earn Street, Invercargill, New Zealand who would be pleased to supply additional information on medium and short-wave listening. All times are quoted in UTC (GMT) which is 11 hours behind Australian Eastern Daylight Time and 13 hours behind New Zealand Daylight Time.*



## **The health risks of EM fields: the debate continues, unresolved**

There's no doubt that this is one of those subjects with so much interest and direct relevance to so many people, it's going to keep coming back into our focus. This month I have some more interesting contributions to our debate, from protagonists on both sides — including an expatriate Aussie researcher who has worked in California for many years, and increasingly found himself a spokesman for those urging more caution in setting 'acceptable' exposure levels to EM fields.

Regular readers of this column may recall that apart from an article written by Tom Moffat in the February issue last year, and a leader that I myself wrote in September 1995, one of the things that triggered our recent discussions of the possible health risks of electromagnetic field was a critical and rather curt letter from a Mr David Samuels, Assistant Science Information Officer at the Australian Radiation Laboratory in Yallambie, Victoria. (The ARL is part of the Commonwealth Department of Human Services and Health.) In that letter Mr Samuels was very critical of both myself and another correspondent, Mrs Betty Venables, essentially telling us that because we were not expert epidemiologists, we should shut up and leave the decisions to the experts.

Well, Mr Samuels has written again, and not surprisingly he and his colleagues at the ARL are still less than delighted with the way we've been discussing the subject. He's what he has to say this time:

*The 'Forum' column (EA October 1996) titled 'The possible health risks of E-M fields: more food for serious thought' is disappointing in that it fails to give a balanced view of the problem. Furthermore the discussion does not make it clear that the possible health hazard of magnetic fields from power lines and electromagnetic radiation from radiofrequency/microwave (RF/MW) transmitters are separate and unrelated issues.*

*The debate really concerns whether current Australian standards and guidelines on exposure to RF/MW radiation or powerline magnetic fields are set at appropriate levels. Authorities justify their position on the basis that:*

- *there is no robust mechanism known by which exposures within the guidelines/standards can elicit a health hazard;*
- *the epidemiological data, which must be the final arbiter in matters of this nature, is weak and inconsistent.*

*An attempt has been made to draw a parallel between the current situation and the health hazard associated with unwitting exposure to ionizing radiation in the early days of radiology. This is inappropriate. In those times there were no exposure standards for ionizing radiation exposure, until 1934, and epidemiological studies were not undertaken to establish a health hazard. These facts do not apply to the matters at hand.*

*A letter from Dr O'Brien states that the Swedish specification MPRII is a standard and also implies that it is a health standard. MPRII is an engineering specification for the manufacture of VDT's unrelated to health hazards. Compliance with this specification is voluntary. The Swedish National Electrical Safety Board stated in early 1995 that they could not foresee any limits for long term exposure to magnetic fields. Most Western countries have safety criteria similar to those existing in this country.*

*I have enclosed literature from the International Commission on Non Ionizing Radiation Protection (ICNRP) and a paper by Moulder and Foster, which represent the establishment's position in this controversy.*

Thank you for those comments, Mr Samuels, and it's good to see that you and the ARL now seem to accept our right to try and discuss such an important subject — if only by implication. I do note that you're still attempting to claim the weight of supposedly unchal-

lenged authority, though, with your use of wording such as 'Authorities justify their position' and 'the establishment's position in this controversy'.

I'm sure that quite a few of the expert protagonists on the 'anti establishment' side (to use your terminology) would want to argue with your bald statement that the possible hazards of fields from power lines and RF/MW transmitters are 'separate and unrelated issues'. Although the two situations certainly seem rather different on the surface, I understand that many researchers have come up with results suggesting there are surprising and disturbing similarities.

Anyway, in publishing your letter hopefully we'll have helped to correct what you apparently saw as a lack of balance in the October column.

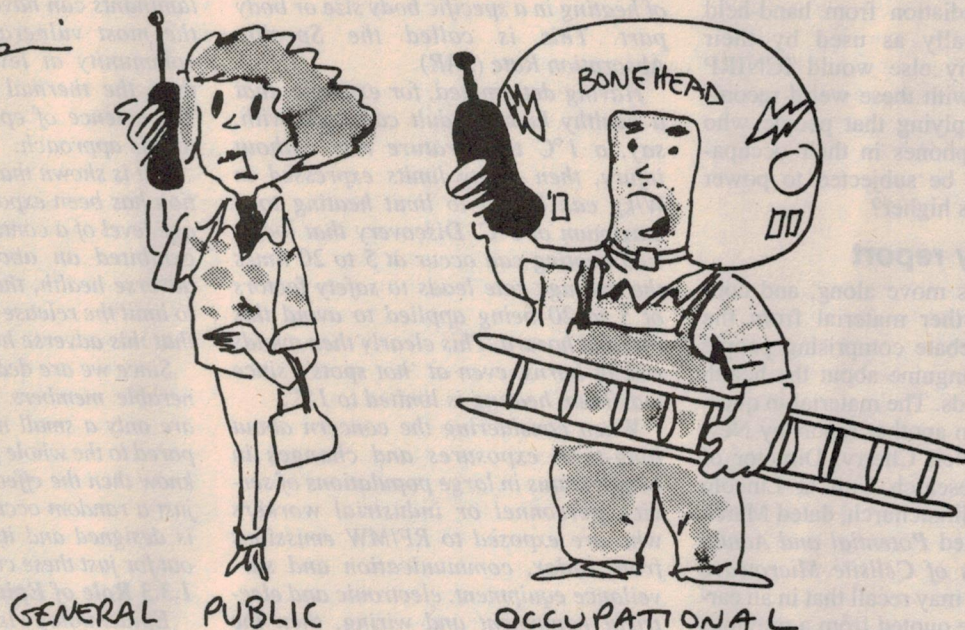
### **ICNIRP statement**

Incidentally one of the papers Mr Samuels enclosed with his letter was a statement by the International Commission on Non-Ionizing Radiation Protection ('ICNIRP'), entitled *Health Issues Related to the use of Hand-held Radiotelephones and Base Transmitters*, dated April 1996. A footnote at the end of the statement notes that at the time it was prepared, the Chairman of ICNIRP was Australian Dr M.H. Repacholi, well known for being on the side of the 'authorities' who doubt that there could be any health risks from field strengths below those which cause measureable heating of tissue.

Perhaps it's not surprising, then, that the ICNIRP statement ends with the following summary:

*Following a critical review of the scientific literature ICNIRP has reached the following conclusions:*

*1. The results of published epidemiolog-*



ical studies do not form a basis for health hazard assessments of exposure to RF fields, neither can they be used for setting quantitative restrictions on human exposure. They do not provide a basis for hazard assessments in relation to the use of hand-held radiotelephones and base transmitters.

2. Data from laboratory studies relevant to cancer do not provide a basis for limiting exposure to the fields associated with the use of hand-held radiotelephones and base transmitters.

3. Limits for human exposure to the fields associated with the use of hand-held radiotelephones and base transmitters should be those of the INIRC (IRPA/INIRC 1988) for whole body average SAR and those of ICNIRP for localised SAR set out in this document.

4. There is no substantive evidence that adverse health effects, including cancer, can occur in people exposed to levels at or below the limits on whole body average SAR recommended by INIRC (IRPA/INIRC 1988), or, at or below the ICNIRP limits for localised SAR set out in this document.

5. At the frequencies and power levels involved in the use of hand-held radiotelephones there will be no concern about shocks and burns.

6. The localised SARs in the head associated with the use of hand-held radiotelephones must be assessed for each frequency and configuration used.

7. For hand-held radiotelephones used in occupational situations, ICNIRP recommends that the localised SAR in the head be limited to 10W/kg averaged over any 10g mass of tissue in the head (0.1W absorbed in any 10g mass of tissue in the head).

8. For hand-held radiotelephones used by the general public, ICNIRP recommends that the localised SAR in the head be limited to 2W/kg averaged over any 10g mass of tissue in the head (0.02W absorbed in any 10g mass of tissue in the head).

9. The use of radiotelephones should be restricted to areas where interference effects are unlikely to occur (for example, well away from hospital intensive care departments and similar locations). Manufacturers of electrical equipment are encouraged to design and manufacture equipment that is insensitive to RF interference.

Hmmm — interesting, don't you think? Especially the apparent dismissal of both the published epidemiological studies and laboratory research studies relevant to cancer. You'll perhaps

remember that in his first letter, the ARL's Mr Samuels basically told Ms Venables and myself that our opinions and concerns were not relevant, because we didn't have the necessary epidemiological knowledge. Now it seems that those pillars of Mr Samuel's 'establishment', ICNIRP and Dr Repacholi, are prepared to dismiss even the expert epidemiologists and researchers!

I don't know about you, but I was also intrigued by those two different recommended SAR levels in the ICNIRP report — one for handheld radiotelephones used in 'occupational' situations, and the other (with a level FIVE times lower) for the same kinds of device used by 'the general public'.

Does this mean that those wonderful ICNIRP authorities have somehow discovered that it's five times less dangerous for people to use hand-held cell-phones as part of their job, rather than for private communications? Or perhaps that working in a job makes your head five times more able to withstand EM fields, than those who aren't working?

I seriously doubt it. I'm more inclined to believe that this quite artificial distinction between 'occupational' and 'general public' levels has something to do with the fact that telco's, big business

and military organisations around the world are very concerned about any prospect of a reduction in the recommended EM radiation from hand-held phones, especially as used by their employees. Why else would ICNIRP have come up with these weird recommendations, implying that people who use hand-held phones in their occupation can safely be subjected to power levels five times higher?

## New Cherry report

Anyway, let's move along, and consider some further material from the 'side' of the debate comprising people who are less sanguine about the health risks of EM fields. The material in question comes from another report by New Zealander Dr Neil Cherry, Director of the Climate Research Unit at Lincoln University in Christchurch, dated March 1996 and entitled *Potential and Actual Adverse Effects of Cellsite Microwave Radiation*. You may recall that in an earlier column I've quoted from a previous report by Dr Cherry, who has apparently given evidence at a number of NZ court enquiries regarding the siting of cellular radio base-station antenna towers, and the possible health risks to people living or working nearby.

This recent report has been loaned to me by Dr Tony O'Brien of Charlestown in NSW, who has of course contributed many times to this discussion. My thanks to Dr O'Brien for his continuing interest and involvement.

Dr Cherry's report runs to 74 pages, and is packed with information. However I found some of the introductory text near the front quite helpful, especially with regard to those two different recommended SAR levels in the ICNIRP statement. Here are the excerpts concerned:

### 1.3 Divergent Approaches:

Faced with the need to protect people from actual or potential harm from exposure to radiofrequency/microwave radiation from machinery, appliances and transmission equipment, industries, including the military, and public health authorities approach the issue from two different directions: industrial injury protection and public health protection.

#### 1.3.1 Industrial Injury Protection:

Intense RF/MW radiation is known and shown to produce tissue heating. The rate of heat absorption varies with frequency and the size of the absorbing object. By studying the absorption characteristics of human bodies and body

parts it has been possible to determine approximately what intensity of incident radiation flux produces a specific level of heating in a specific body size or body part. This is called the Specific Absorption Rate (SAR).

Having determined, for example, that a healthy human adult can cope with, say, a  $1^{\circ}\text{C}$  temperature rise without injury, then safety limits expressed in W/kg can be set to limit heating to a maximum of  $1^{\circ}\text{C}$ . Discovery that localized heating can occur at 5 to 20 times the average rate leads to safety factors of 5 to 20 being applied to avoid this thermal hazard. This clearly then avoids risk of burns, even at 'hot spots', since maximum heating is limited to  $1^{\circ}\text{C}$ .

When considering the concern about long-term exposures and changes in health status in large populations of service personnel or industrial workers who are exposed to RF/MW emissions from radar, communication and surveillance equipment, electronic and electrical equipment and wiring, then the presumption has been made that the safety factor already applied should be sufficient to protect the personnel from health risks.

## Basis of standards

International exposure standards are based on this approach and these assumptions. A position has developed that stricter standards should only be applied if it can be proved beyond reasonable doubt that an adverse health effect does actually occur at a lower level of exposure.

Present national and international RF/MW exposure standards committee are dominated by people who take the industrial safety exposure position and hence are maintained at present high levels. A recent move to relax the Australia/New Zealand standard was proposed and adopted, based on thermal safety arguments only. Telecom and BellSouth-related staff, and their health consultants who are also on the Standards Sub-committee, Dr Michael Repacholi and Dr David Black, all come from the industrial thermal injury approach. This is documented in submissions and evidence presented to hearing, and to the Planning Tribunal.

#### 1.3.2 Public Health Protection:

The approach of public health protection epidemiologists and officials recognizes that while it may be guaranteed that an SAR of  $0.08\text{W/kg}$  will protect

people from burns and adverse health effects due to body temperature rise, long-term exposure to low levels of contaminants can have an adverse effect on the most vulnerable members of the community at levels somewhat lower than the thermal protection standard. The science of epidemiology is central to this approach.

If it is shown that a subset of a population has been exposed to an above average level of a contaminant and they have exhibited an above average level of adverse health, then there exist grounds to limit the release of that contaminant so that this adverse health risk is avoided.

Since we are dealing with the most vulnerable members of a community there are only a small number of people compared to the whole population. How do we know then the effect is significant and not just a random occurrence? Epidemiology is designed and its analyses are carried out for just these circumstances...

#### 1.3.3 Role of Epidemiology:

Epidemiology is the critical science in this area and in this hearing. Epidemiologists study groups or populations of people. People's physical features are very naturally varied, including the strength of the immune system protection against a very wide spectrum of infections, viruses and effects of contaminants. When an epidemiologist studies a particular population who are known or suspected to be exposed to an above average level of a contaminant, she or he may find a statistically significant increase in particular health indicators. They then attempt to identify other factors such as smoking, income level, age, disease history, sex and occupation, called confounders. Confounders are studied carefully because they might be influencing the results. Often they are successfully dealt with, the relationships adjusted appropriately and the residual relationship produces clear and strong conclusions. In other cases, initial findings are discounted because the confounders have probably caused the adverse effects which are being studied.

#### 1.3.4 False claim of a decrease in cancer rates:

It is often claimed that if EMR was carcinogenic, then the significant increase of EMF exposure of large populations over the recent five decades would have shown a well related increase in cancers. This claim goes on to say that there hasn't been an increase

of cancer and so this must prove that electromagnetic radiation exposure does not cause cancer.

This is a very simplistic approach and is scientifically able to be disproved. Firstly, many of the particular cancer types which have been identified to have elevated risk levels related to EMR exposure — leukaemia for example — are showing upward trends both in New Zealand and around the world. It is important to differentiate between the incidence of cancer and mortality, because more successful treatment can reduce mortality while the incidence goes on increasing.

'Projections of the cancer burden in New Zealand', (Cox (1995), produced by the Public Health Commission, reports that 'All cancer' age standardized incidence per 100,000 (and mortality in brackets) has increased from 140 (175) in 1957-61 to 169 (291) in 1987-91 for males and from 110 (154) to 127 (321) for females. Hence the percentage increase of incidence has been 66% over 30 years for males and 108% for females. Part of the increase is in improved detection and diagnosis, as well as a small effect from a progressively aging population.

Epidemiology has identified risk increase relationships between exposure to electromagnetic radiation and leukaemia in children and in adults, other blood cancers, brain and central nervous system cancers, melanoma, lung cancer, breast cancer in women and men, stomach, gastric and esophagus cancer, testicular cancer, and colon and rectum cancer. Some confounders are very evident for a number of these, such as smoking and air pollution for lung cancer, ultraviolet radiation for melanoma, diet for stomach cancer, and benzene for leukaemia. Of those that are reported in the PHC report only the incidence of stomach cancer in males and females has decreased over this 30 year period.

Therefore, despite the existence of confounders, the potential association between increased exposure of the population to electromagnetic radiation and cancer still exists and is significantly strengthened by many epidemiological studies and research into biological mechanisms.

I hope you find this explanation as informative as I did, and I hope Dr Cherry will again not object to my reprinting it here. Oh — just before we move on again, here's another little excerpt from Dr Cherry's report that I also found quite informative:

The nature and style of evidence favoured by the applicant company is well

documented. A leading proponent of a 'no-effect without significant heating' approach is Dr Michael Repacholi. In New Zealand this position is also taken by Dr David Black. Dr Michael Repacholi is a recognised world expert on setting RF/MW standards. He chairs the joint Australian/New Zealand standards sub-committee on RF/MW standards. Dr Black is a member of this committee.

Dr Repacholi is carrying out an industry funded A\$1.2 million study of the effect of RF/MW radiation on a population of mice, with the publicly stated aim of proving that RF/MW exposure at sub-thermal levels is safe. Dr Repacholi frequently gives evidence to hearings around the world and Planning Tribunal hearings in New Zealand. Dr Repacholi appeared on behalf of BellSouth at a Christchurch cellsite Planning Tribunal Hearing in November 1995. In his evidence to the Planning Tribunal he stated (Section 54.2):

**"To produce any adverse effect, RF exposure above a threshold must occur. This threshold level is the RF exposure needed to increase tissue temperature by at least 1°C. The low RF power levels from base transceiver stations cannot possibly cause this temperature rise."**

Hmmm — that's a rather definite statement, isn't it, and coming from the Chairman of ICNIRP himself. It again doesn't give one much confidence that ICNIRP's position is based on an objective and open-minded consideration of all the available evidence...

That's all I'd like to quote here from Dr Cherry's report, but I can certainly commend it to you if you are interested in further reading. I believe copies will be available in Australia from Don Maisch at EMFacts Information Service, PO Box 96, North Hobart 7002; phone (0362) 430195, or email to [maisch@netspace.net.au](mailto:maisch@netspace.net.au).

### Expatriate Aussie

Anyway, let's move on again. I'm delighted to report that thanks to a little help from Tom Moffat in the USA, I was finally able to make contact with Professor W. Ross Adey, in California. You may recall that we've had references to Professor Adey's work in various earlier columns, and in December's column we learned that he's both an expatriate Aussie and an active radio amateur — as well as a leading researcher in the field of biological effects of EM fields.

When I sent an e-mail message to Professor Adey, asking if he would care to contribute to our discussion, within a day or so I received the fol-

lowing very friendly reply (I have shortened it a little):

It was a very pleasant surprise to get your e-mail. I recall the time when you joined the staff of Radio & Hobbies! I had already left Australia — I have been in California since the middle 50s.

My first amateur license in 1939 was VK5AJ. Later in Melbourne my call was VK3AJL. I had a licence in Oxford in 1950-51 as G3GPC. My first American license in 1962 was WB6DEX. I got one of the early Extra Class licences in 1974 as K6UI. I am still very active on all HF bands and do a lot of satellite work on 145 and 435 MHz. I still homebrew most of my equipment, including a synthesized, microprocessor controlled HF transceiver that grew out of a Heath prototype, and all the VHF/UHF SSB exciters and linears.

I did some moonbounce with a novel coherent detection system back in the late 60s, (published it in QST). That, by the way, grew out of my association with David Robertson VK5RN, in his pioneering work at the Uni of Adelaide in meteor trail Doppler studies in 1946-49. We started that with our ham gear on 27MHz, before the CB was ever thought of!

In response to your e-mail, I have sent an airmail package of reprints of work by our own group and by other people. They summarize much of the work in cell and molecular biology, and in the biophysics of EM field interactions with living systems.

As a background, my team is one of the largest working on the problems of potential health hazards. It is reasonable to say that we have made a number of the pivotal contributions since we began in the late 1960s. Our approach

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has been a continuing effort to learn about the basic mechanisms mediating tissue interactions that are not based on heating effects.

At first, we were treated by both biomedical people and by the physicists as being more than a little kooky. Now, it has become clear that we have been quite correct. This has become the accepted viewpoint — except, perhaps, for a few people like Michael Repacholi, who continue to proclaim very publicly in realms where they believe that they are safe from challenge, that these fields lack the energy to break chemical bonds, and that therefore there can be no significant bioeffects...

Wrong, Michael, dead wrong. Because a very possible mode of their interaction is with free radicals that are not produced by the fields, but are produced in the course of every ongoing chemical reaction. Breaking of chemical bonds is an inherent aspect of every chemical reaction, and with it free radicals must be produced.

We and others have some very exciting experimental evidence in support of these free radical interactions. But that is a very small corner of a very large picture.

A week or so after receiving this reply, a big envelope arrived from Professor Adey, containing the stack of reprints of research papers and other literature he had sent. Many of these are pretty deep stuff, and fairly heavy going for anyone who isn't a specialist in the field concerned. However after wading through it all, I did manage to find a couple of sections which I believe you'll find of interest and value.

Here's an excerpt from a paper called 'Collective Properties of Cell Membranes', which Professor Adey contributed to the book *Interaction Mechanisms of Low-Level Electro-magnetic Fields in Living Systems*, edited by Bengt Norden and Claes Ramel (Oxford University Press, 1992):

#### **Observed biological sensitivities to imposed EM fields**

By reason of a much higher conductance in the extracellular space (ECS) than in current pathways that pass through membranes, the ECS is the primary route for induced tissue components of environmental EM fields (Cole 1940). Typical cell membrane resistances are in the range 3000-100,000  $\Omega/\text{cm}^2$ . Extracellular fluid has a much lower specific resistance, in the range 50  $\Omega/\text{cm}^2$ . Measurements of dielectric dispersions indicate that cell

membranes behave reactively at frequencies as high as the low gigahertz range (Schwan 1974).

Thus, although the ECS forms only about 10% of the conducting cross-section of typical tissue, it is clearly a preferred pathway, carrying at least 90% of any imposed or intrinsic current, and directing it along cell membrane surfaces.

Our studies of current flow along cell membrane surfaces have shown its interaction with anionic fixed charges on glycoprotein strands protruding into the ECS from the plasma membrane, and suggested a functional role for this cell-surface compartment (Elul 1966, 1967). For this reason, we have found that focal measurements of electrical impedance in small brain tissue volumes are indicators of changing physiological states (Adey et al. 1962, 1966). 'Electrical impedance changes accompanying physiological responses may arise in perineuronal fluid with a substantial macromolecular content and calcium ions may modulate perineuronal conductivity' (Adey 1966).

As a perspective on the biological significance of this cell-surface current flow, there is evidence from a number of studies that ELF fields producing tissue gradients as weak as  $10^{-7}\text{V}/\text{cm}$  are involved in essential physiological functions in marine vertebrates, birds, and mammals (reviewed by Adey 1981a) (Table 4.1). In vitro studies have also reported similar sensitivities for cerebral  $\text{Ca}^{2+}$  efflux (Bawin and Adey 1976) and in calcium-dependent processes in bone growth (Fitzsimmons et al. 1986, 1989).

With radiofrequency (RF) fields that are amplitude-modulated at ELF frequencies (typically 0-100Hz), induced fields can be substantially higher than with the simple ELF fields cited in Table 4.1, due to increased coupling between RF fields and tissue (reviewed by Adey 1981a).

Thus, whereas a 60Hz electric field of 10kV/m in air induces a maximum field in the human body around  $10^{-4}\text{V}/\text{cm}$ , a 100MHz RF field with an incident energy of 1.0mW/cm<sup>2</sup> (61V/m in air) would induce human brain tissue gradients in the range 10-100mV/cm. These levels are in the same amplitude range as intrinsic oscillations, such as the electroencephalogram (EEG) when measured at the dimensions of a single cell.

Induced RF fields at these higher tissue levels remain 'athermal' but also produce a wide range of biological interactions that appear to be totally

dependent on the characteristics of the imposed low-frequency amplitude modulation and unrelated to the presence of an unmodulated carrier wave at the same intensity.

These responses include entrainment of brain EEG rhythms at the same frequencies of the ELF components of imposed fields, and modulation of brain and behavioural states (Bawin et al. 1973); and, in non-nervous tissue, strong effects on cell-membrane functions, including modulation of intercellular communication through gap-junction mechanisms (Fletcher et al. 1986), reduction of cell-mediated cytolytic immune responses (Lyle et al. 1983), and modulation of intracellular enzymes that are molecular markers of signals arising at cell membranes and then coupled to the cell interior (Byus et al. 1984, 1988). **Electrophysiological benchmarks in cell-membrane functions:**

Most cells in the resting state have a steady membrane potential of approximately 0.1V between the inside and the outside of the cell, due to differential concentrations of  $\text{K}^{+}$  and  $\text{Na}^{+}$  ions in these two compartments. The interior of the cell is negative with respect to the exterior. This membrane potential exists across the extremely thin plasma membrane, typically about 40Å thick; a membrane so thin that, in consequence, there is an enormous electric gradient of  $10^8\text{V}/\text{cm}$  across the cell membrane. This large gradient is altered by  $10^3\text{V}/\text{cm}$  in synaptic activation in nerve cells (Table 4.1). In sharp contrast, physiological electric oscillations in fluid surrounding cells are many orders of magnitude weaker than this natural barrier of the membrane potential.

#### **Dramatic comparison**

As a perspective on this disparity between the gradient of the membrane potential and observed cell sensitivities to weak electric gradients in surrounding fluid, we may model the membrane potential as a conducting sheet with a charge of 100kV and placed only 1cm above the ground.

In sharp contrast, cell sensitivities to gradients as weak as  $10^{-7}\text{V}/\text{cm}$  may be modelled for fluid surrounding the cell by connecting one terminal of a 1.5V battery to a wire in the Pacific Ocean at San Diego and the other battery terminal to a wire in the ocean at Seattle, 2000km away. There would then be a gradient of  $10^{-7}\text{V}/\text{cm}$  across every centimetre of the intervening ocean.

Thus, it is not surprising that such weak electric gradients have been denied a physiological role. Neverthe-

**Table 4.1 Bioelectric sensitivities to ELF fields**

	Function	Tissue gradient	Imposed field
Sharks and rays	Navigation and predation	$10^{-8} \text{ V cm}^{-1}$	d.c. to 10 Hz
Birds	Navigation	$10^{-7} \text{ V cm}^{-1}$	0.3 gauss
Birds	Circadian rhythms	$10^{-7} \text{ V cm}^{-1}$	10 Hz, $2.5 \text{ V m}^{-1}$
Monkeys	Subjective timing	$10^{-7} \text{ V cm}^{-1}$	7 Hz, $10 \text{ V m}^{-1}$
Man	Circadian rhythms	$10^{-7} \text{ V cm}^{-1}$	10 Hz, $2.5 \text{ V m}^{-1}$
Comparison with intrinsic cell and tissue neuroelectric gradients			
	Membrane potential	$10^5 \text{ V cm}^{-1}$	
	Synaptic potential	$10^3 \text{ V cm}^{-1}$	
	Electroencephalogram	$10^{-1} \text{ V cm}^{-1}$	

less, many organisms, including man, are sensitive to tissue gradients in the range 0.1-100mV/cm (Adey 1981 a,b). These sensitivities have been confirmed in cell and tissue cultures for many cell types, including lymphocytes (Lyle et al. 1983, 1988; Byus et al. 1984), liver cells (Byus et al. 1987), ovary cells (Byus et al. 1988), bone cells (Luben et al. 1982; Luben and Cain 1984; Cain and Luben 1987; Cain et al. 1987), cartilage cells (Hiraki et al. 1987), and nerve cells (Dixey and Rein 1982). Embryonic bone formation is increased by exposure to even far weaker fields, down to  $10^{-7} \text{ V/cm}$  (Fitzsimmons et al. 1986, 1989).

As you can see, even this excerpt is fairly technical, but I hope it gives you at least an idea of the kind and amount of evidence that researchers like Professor Adey have amassed regarding the interaction of quite weak EM fields with various types of cells in the human body. I've reproduced Table 4.1 from Professor Adey's paper, by the way, so you could refer to it while reading the above.

And finally this month, here's the final section from another of Professor Adey's papers, this one entitled 'A Growing Scientific Consensus on the Cell and Molecular Biology Mediating Interactions with Environmental Electromagnetic Fields', which is apparently printed in the book *Biological Effects of Magnetic and Electromagnetic Fields*, edited by S. Ueno (Plenum Press, New York 1996). I think it provides quite a good ending for both his paper, and this month's column:

#### SUMMARY AND CONCLUSIONS

Over the past 15 years, there have been emergent concerns that the great and growing use of electric power and radiofrequency communication systems throughout the world, with immeasurable benefits to all mankind, may carry a burden of adverse health effects. In this same era, research to evaluate levels of possible hazards has followed a dual course, with epidemio-

logical and laboratory studies proceeding in parallel, but with few options for coordination.

The scope and content of this laboratory research in bioelectromagnetics has been significantly fettered in scope and content, because the only major sources of its quite meagre funding through government agencies has come from mandates in hazard research.

Despite these encumbrances, bioelectromagnetic research appears to have swept beyond immediate goals in hazard research, to approach a first understanding of the essential nature of living matter in terms of physical processes at the atomic level, far beyond the realm of chemical reactions in a biomolecular fabric.

Laboratory studies have identified cell membranes as the primary tissue site of interaction with environmental electromagnetic fields. They have determined major sequences in the coupling of cell surface signals to a cascade of high energy enzymatic mechanisms inside cells, including mechanisms regulating cell growth. These studies point to joint actions of chemical cancer promoters and EM fields at cell membranes as key steps in tumour formation. The role of free radicals in first detection of EM fields at athermal levels is supported by biophysical models and experimental data.

On the one hand, the importance of this new knowledge emphasizes emergence of bioelectromagnetics as an interdisciplinary field at the frontier of both physical and life sciences, holding prospects for major new advances in understanding functions of the human body in health and disease. On the other, without much further fundamental research, there are few prospects of developing a metric for tissue dose in EM field exposure; and without a metric, further epidemiological studies appear to hold little prospect of major progress.

The last decade has seen a progres-

sive erosion of the normal evaluation of new knowledge by qualified experts in particular fields of medical science and medical practice through peer review and collegial exchange. In its place, there is the troubling spectre of corporate lawyers importunate in their pursuit of research still in progress, in espousing a litigant's cause, rather than diligent in legal discovery aimed at establishing scientific credibility. This is exemplified in publicity afforded courtroom distortions of painstakingly acquired knowledge about interactions of the human body with environmental electromagnetic fields.

More than 1900 years ago, Tacitus knew well the fate of a Roman society that had abandoned itself to the machinations of lawyers:

**"If no one paid for lawsuits, there would be less of them! As it is, feuds, charges, malevolence and slander are encouraged. For just as physical illness brings revenue to doctors, so a diseased legal system enriches advocates."**

And with those wise words from Tacitus, via Professor Adey, I'll leave you for another month. My grateful thanks to Professor Adey for finding the time to contribute to our discussion. ♦

## VALE NEVILLE WILLIAMS

Gary Johnston and the staff of Jaycar Electronics wish to extend their deepest sympathy to the family and friends of the late Neville Williams, former Editor in Chief of Electronics Australia.

From our long association with the magazine we know that he will also be sadly missed by all of its readers and advertisers, as well as by Jim Rowe and his staff.

# Circuit & Design Ideas

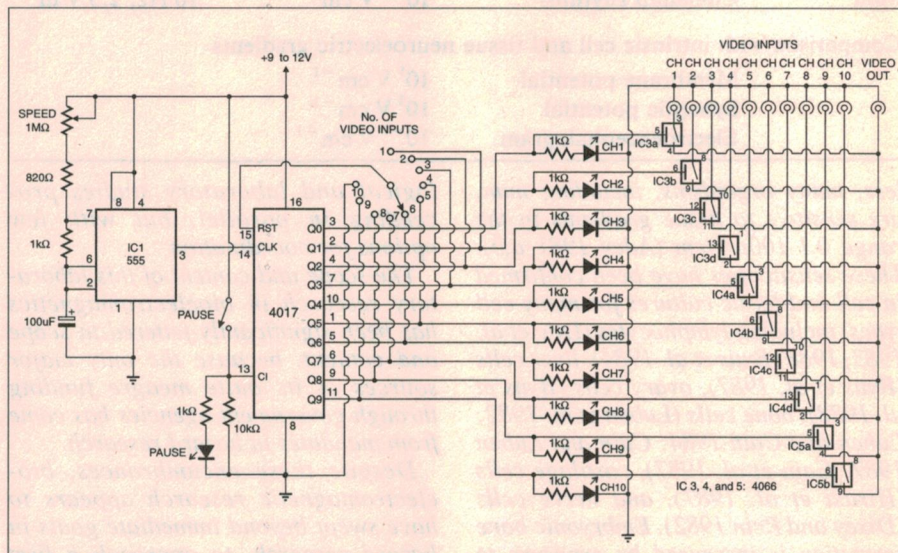
Interesting circuit ideas from readers and technical literature. While this material has been checked as far as possible for feasibility, the circuits have not been built and tested by us. We therefore cannot accept responsibility, enter into correspondence or provide any further information.

## Automatic video switching circuit

This circuit can be used to sequentially switch up to 10 video (or audio) sources, and is similar to those found in CCTV systems. However the circuit is not restricted to CCTV cameras as any composite video source or line level audio source can be used.

Several 4066 CMOS analog switches are used to switch the 10 video/audio sources. In addition, a 4017 decade counter and a 555 timer are used to automatically switch the signal from each source in turn. The speed at which the circuit switches can be adjusted from approximately half a second to over a minute using the 1M potentiometer. If required, the automatic sequencing can be paused (a very useful function in CCTV monitoring) by pulling the clock enable pin of the decade counter high. This is achieved by pressing the pause switch — preventing the counter from advancing to the next signal input.

The 10-position rotary switch is used to select the number of signal sources



used, so that you don't have to step through the unused channels at the end of each cycle.

I've found that 4066 switches tend to have an on-resistance of around 90 to 150 ohms, varying from manufacturer to manufacturer. This series resistance results in

some loss in the video signal, but in my application this small loss was acceptable. (With some experimentation I found that National Semiconductor CD4066BCN had the lowest resistance, of 90 ohms.)

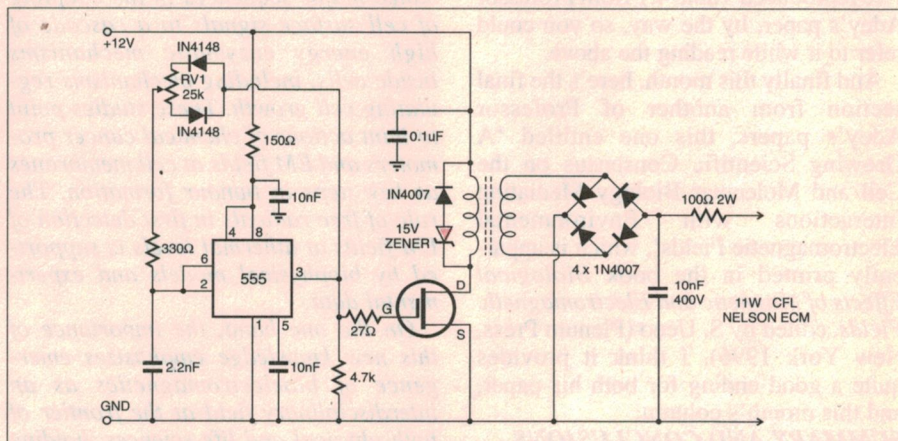
Michael Cheng  
Woden, ACT \$40

## 12V supply for CFL lamps

This circuit was inspired by a couple of recently published designs, and is used to run a CFL (compact fluorescent light) on a boat. It uses readily available parts, and powers an 11-watt tube from a 12V supply.

T1 is a Jaycar LF1270 ferrite transformer assembly with 12 turns of 20 gauge B&S enamelled copper wire in the primary and 220 turns of 30 gauge in the secondary. The 555 operates at about 120kHz, and RV1 is adjusted to vary the duty cycle from minimum to a point where the light starts reliably. (In the prototype this was about one third from the minimum setting.) With an 11W Nelson ELM CFL it draws about 850mA from a 12V battery, and Q1 remains cool to the touch. Other circuits have specified high speed diodes, but I found that 1N4007's worked satisfactorily.

The 15V Zener and 1N4007 silicon



diode serve to protect the drain of the MOSFET, while the 0.1μF capacitor provides a degree of filtering. I included the 100 ohm resistor in series with

the output to minimise the turn-on current in the lamp.

Greg Fisher  
Parkside, SA \$40

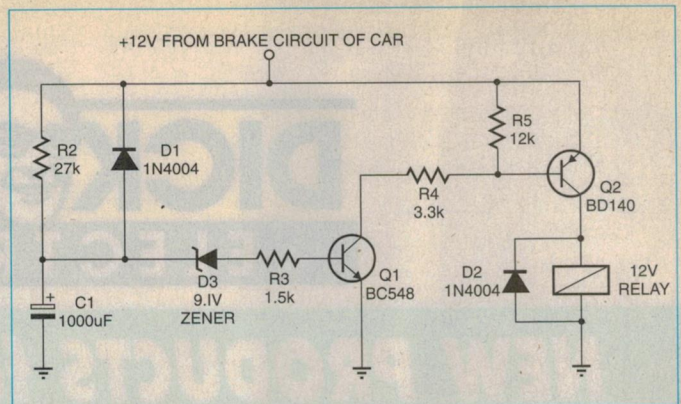
## WIN OUR 'IDEA OF THE MONTH' PRIZE!

As an added incentive for readers to contribute interesting ideas to this column, the idea we judge most interesting each month now wins its contributor an exciting prize, in addition to the usual fee. The prize is a compact CCD video camera module from sponsor Allthings Sales & Services, offering 460 TV lines of horizontal resolution and 0.05 lux sensitivity, and valued at \$199.00!

## Brake pedal alarm

I was recently approached by a mechanic friend to design a simple timer to sound a buzzer if the brakes have been applied for more than 30 seconds. The owner of the (manual transmission) car complained that he was going through brake pads far too quickly, due to his bad habit of resting his foot on the brake pedal whilst driving.

+12V is supplied from the car's brake circuit, switching on whenever the brake pedal is pressed. C1 begins to charge via R1, and after about 30 seconds, C1 reaches approximately 9.7V. At this point, Q1 has 0.6V on its base, due to the 9.1V dropped by Zener diode D3. Q1 then switches on, supplying 12V to the relay which can be used to activate buzzers, warning lights, etc. Resistor R2 and diode D1 are used to quickly discharge C1 when the brake pedal is released.



Peter Howarth, Gunnedah, NSW \$35

## Capacitance adapter for analog multimeters

When combined with an analog multimeter, this adapter can measure capacitance values from 10pF up to 1000uF with a basic accuracy of +/-5%.

The circuit employs two 555 timers, with IC1 running in astable mode and IC2 configured as a frequency to voltage converter. The unknown capacitor Cx is connected in parallel with the

selected timing capacitor Co, so IC1's output frequency is:

$$F_{out} = 1.38 / (R_o(C_o + C_x))$$

This means that the higher the value of Cx, the lower the frequency out of IC1, resulting in a lower output voltage from IC2.

When no capacitor is connected to the input terminals, Cx = 0, thus Fout = 1.38/(Ro Co), and IC2 will produce its maximum output voltage (2.5V), which is the meter's minimum capaci-

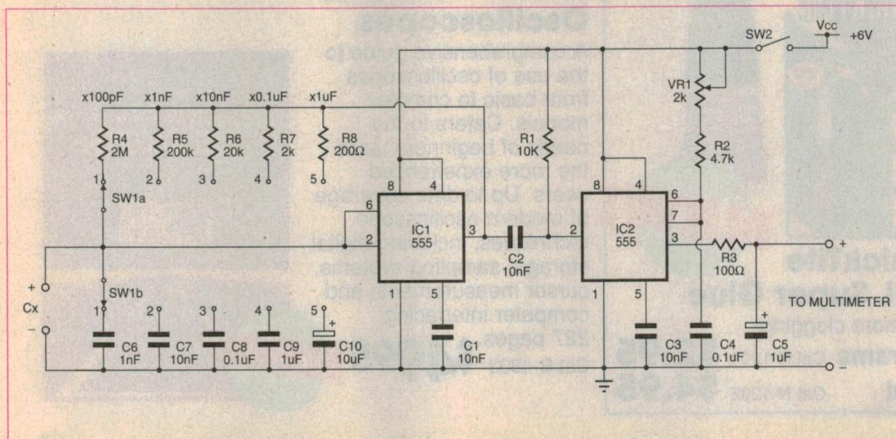
tance reading. If a very large capacitor is connected, Co + Cx will be huge, and Fout will be close to zero. With no input frequency, IC2's output will drop to 0V, which indicates the meter's maximum capacitance reading.

The relationship between the value of Cx and the deflection of the meter's needle closely matches the ohms scale printed on the face of the meter. It is a simple matter then, to set the multimeter to its 2.5V range, and read the capacitance value directly off the meter's ohms scale. Use VR1 to set the meter for a zero reading with no capacitor connected, and SW1 to select ranges. (For best accuracy, select a range that gives a reading somewhere in the centre of the scale.)

The circuit is designed for an analog multimeter that has a 2.5V DC range, such as the Dick Smith Electronics Q-1015 and Q-1027.

Weimin Liu  
Liverpool, NSW.

\$40 ♦



## Easy remote control tester

Did you know you can make a remote control tester out of any phototransistor or photodiode?

Just connect it to your normal oscilloscope input, point the remote at it and you can view the waveform quite easily, without any extra circuitry.

Since nearly every problem with remote controls involves the loss of infra-red output signal, you're well on your way to repairing your own remote controls.

Any photodiode or phototransistor will do, but try a few different types because their output performance

varies tremendously. I used a BPW50 because it was not very directional and had the highest signal output. (It also contains an intrinsic IR filter, blocking out any visible light.)

For a lovely permanent setup find a plug cover (6.5mm phono or 5-pin DIN maybe) which neatly fits over a BNC connector. Mount the sensor inside and secure it all with Araldite. The BNC connector now just fits onto your CRO.

Even when completely filled with Araldite there is ample signal level displayed on the CRO with the remote over 300mm away.

John Smyth  
Greystanes NSW

\$30

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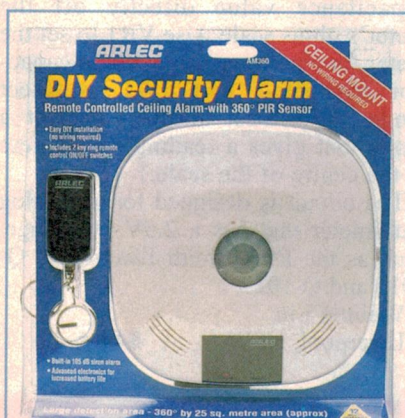
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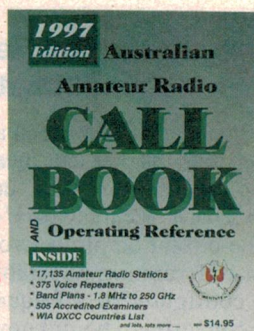
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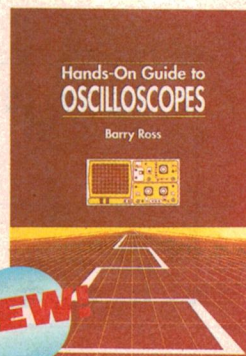
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


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(line inputs, typical load)

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Bypass mode: 15Hz to 30kHz  $\pm 0/-1$ dB  
Tone mode: 20Hz to 20kHz  $\pm 1$ dB with controls set to 'flat'

#### Total harmonic distortion

(20kHz bandwidth, typical load, at 1VRMS output)

Direct mode: Unmeasurable  
Bypass mode: Less than 0.002%  
Tone mode: Less than 0.002%  
Input and output levels

#### Input and output levels

(Volume control at maximum, line inputs)

Direct mode: 1V in for 1V out (max output: unrestricted)  
Bypass mode: 240mV in for 1V out (max output: 7V RMS)  
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Dec '96/Jan '97

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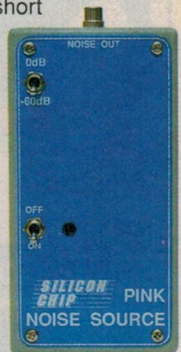
This project is used as an aid to calibrating the Sound Level meter adaptor (K 7208). Can also be used as a general purpose audio noise signal. Supplied in short form with PCB and components only.

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Not available in all stores but may be ordered. Case optional.

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## 10/20MHz Comb Generator

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Oct '96

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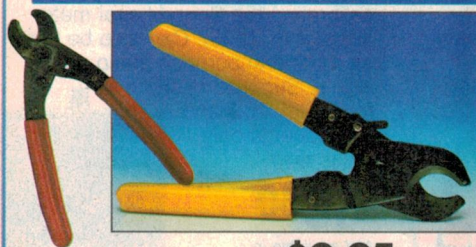


Dec '96

**Availability:** Our kits consist of many different parts from numerous suppliers. Whilst we have consulted closely with them and are satisfied as to their ability to supply, sometimes problems can arise in obtaining all of the parts. This means there is a slight chance that availability may be delayed. Rainchecks are available, however if you'd like to check beforehand, please don't hesitate to contact your local store.

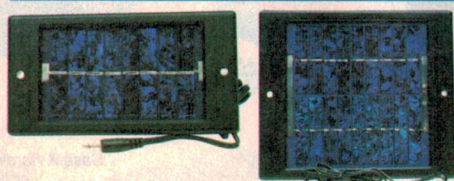
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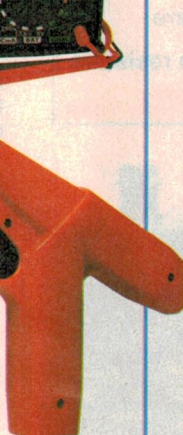


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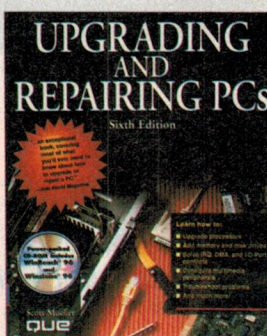
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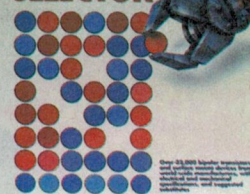
- Shifts the focus from IBM PCs to Intel-based systems
- Updated to address Windows 95 & Windows NT Version 4.0 issues and concerns as well as recent enhancements including issues on the Internet
- New sections included - "Building Your Dream Machine" and "Building Your Dream Server"
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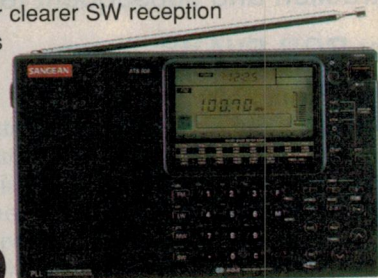


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## Construction project:

# HIGH PERFORMANCE PLAYMASTER PREAMP - 2

In last month's issue, we introduced our new Pro Series Four stereo control unit and described its design goals and circuit operation. In this second and final instalment, we discuss its construction and subsequent testing.

by ROB EVANS

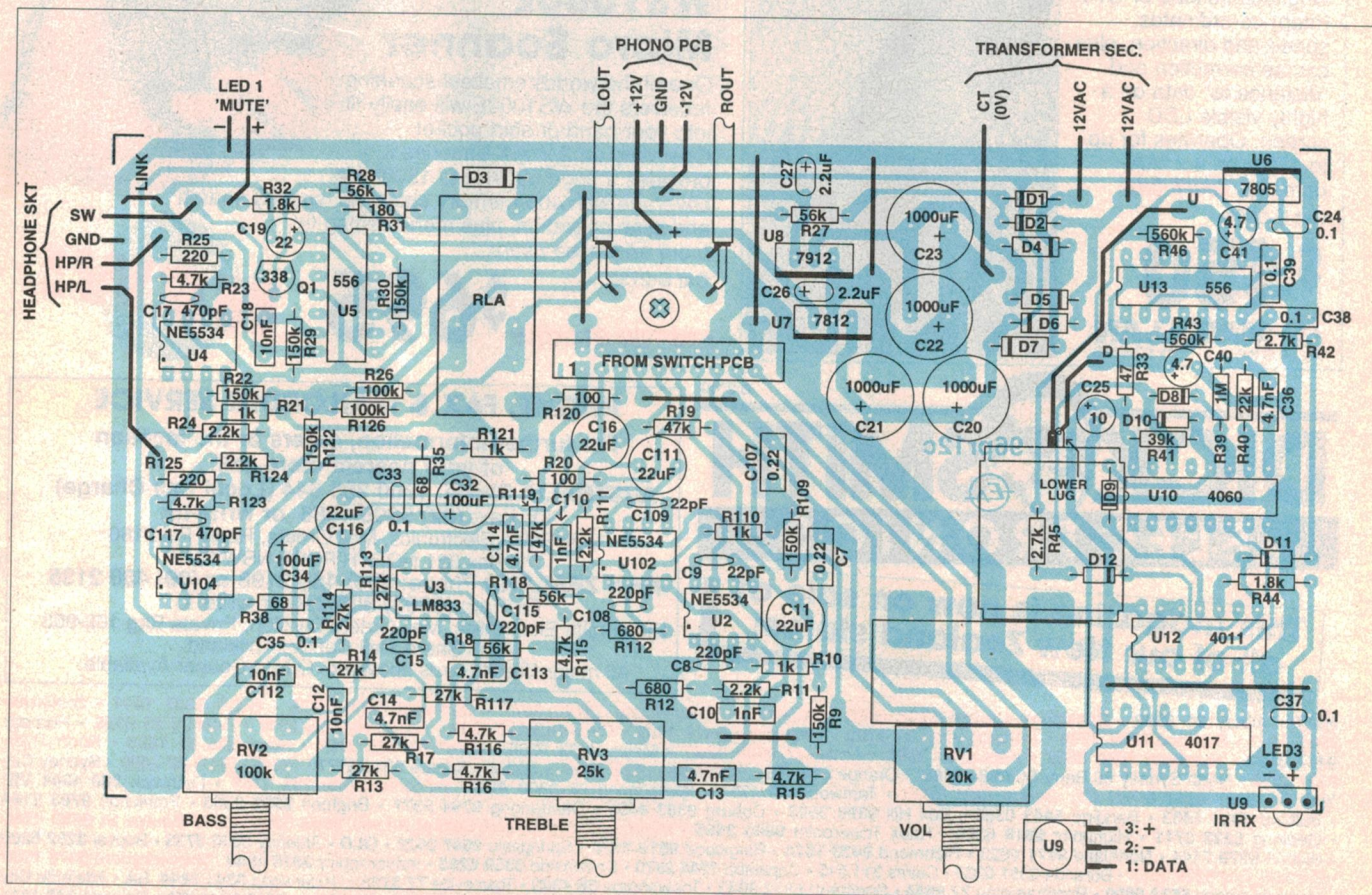
As with other designs in the Playmaster Pro Series range, a substantial part of the preamp's development time was spent on arriving at a physical construction and layout that would make the unit easy to build and service. This, plus the need to use readily available hardware components, keep the overall cost of the preamp to a minimum — plus of course, maintain the highest practical level of audio performance — meant that a somewhat unconventional construction arrangement was needed.

The results of this effort can be seen from the interior shots of prototype, which shows the preamp's uncluttered modular style of construction and lack of interwiring. As you can see, *all* of the preamp's components — including the input/output connectors — are mounted on printed circuit boards (PCBs), and the majority of signals are passed between these boards via standard IDC ribbon cable and matching header plugs.

There are three relatively small circuit boards (four, including the optional

phono preamp board) which mount directly onto the case panels via their PC-mount pots, switches or connectors, and these are simply plugged together via the IDC cables to form the complete preamp. The small amount of interwiring that does need to be completed is quite straightforward, and should not present any difficulty to even inexperienced constructors.

The metal case for our prototype unit was supplied by Jaycar Electronics, and is of a relatively simple but robust construc-



*With the exception of the optional phono preamp, all of the unit's active circuitry is held on the 'main' board shown here. Closely follow this component overlay diagram during construction.*

tion with a folded steel shell and top panel, plus an aluminium front dress panel 3mm thick. It measures around 410 x 255 x 50mm and unlike some traditional rack-mount cases, does not need to be assembled from a collection of supporting bars and panels. Its actual dimensions are not overly critical, and those who wish to construct their own case can vary the size to some degree — just ensure that there is sufficient panel space to accommodate the PCBs and front panel artwork.

By the way, we'd like to thank Jaycar Electronics for their help in supplying key components for this project, and in particular Tim Rimington from their kit department for his suggestions and cheerful cooperation with the Pro Series audio projects.

As is usually the case with this type of construction project, the best place start the process is with the assembly of the PCB modules. We'd suggest that you take your time with this important stage, as mistakes will much more be difficult to spot and correct at a later time. Needless to say, we'd strongly recommend that you refer to the component overlay diagrams at all times, and pay particular attention to the orientation of polarised components such as electrolytic capacitors and semiconductors.

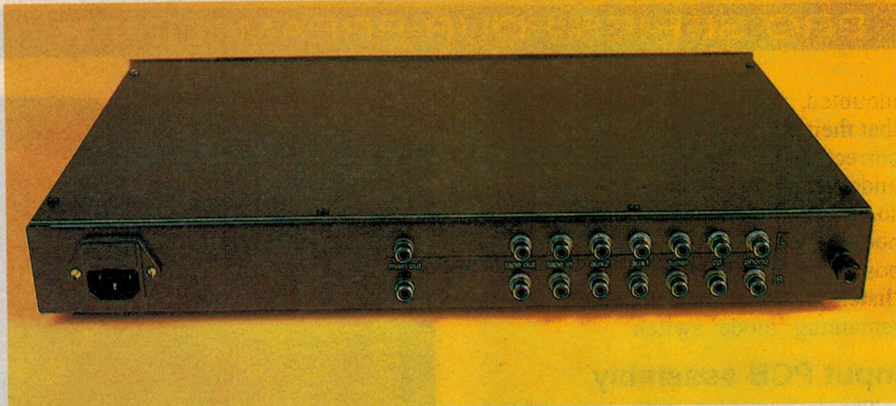
We should also point out that there were a couple of minor errors in the schematic diagrams presented last month; C36 and C3 are shown with a reversed polarity (the negative plates should in fact face towards U1a), and the infrared receiver's C36 should be 4.7nF rather than 4.7uF. The component overlay diagrams are correct.

## Main PCB assembly

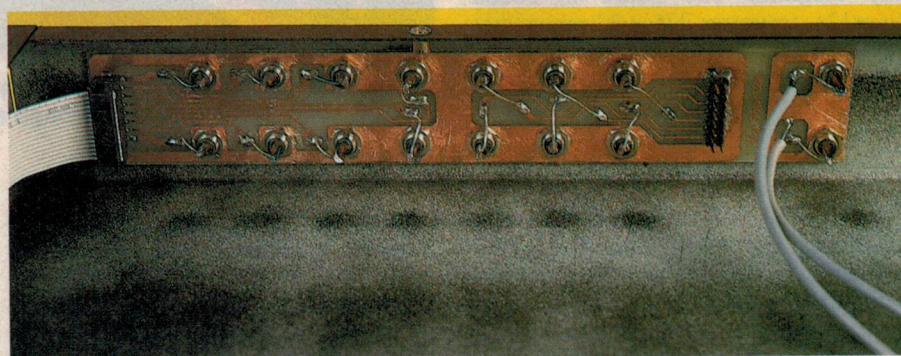
The preamp's main PCB holds all of the circuit's active components (including the power supply) and is a working unit in its own right. In fact by connecting the power transformer to the completed board, it can be fully tested before being installed in the case or connected to the other PCB assemblies. This board is coded 96pr12c and measures 161 x 89mm.

Start by fitting the low profile parts such as resistors and the seven links, working your way though to the larger components such as the relay and motor-drive pot assembly. We used PCB pins for all of the external connection points, and fitted a 20-way length (10 x 2) of DIL header strip to serve as a 'plug' for the external IDC cable connector — the header will need to be trimmed from a standard 25- or 40-way length of header strip.

Other than that, note that the two leads



**An outside view (shown above) and inside view (below) of the input/output RCA sockets. The 'input' PCB is mounted copper-side out, and provides both the electrical insulation and connection paths for all 16 RCA sockets.**



connecting to the volume control's motor are marked 'U' and 'D' — signifying the up and down drive — and the 'D' lead should be connected to the motor's lower terminal lug, as shown in the overlay diagram. Also, LED3 ('remote') needs to be installed so that the body is about 20mm above the PCB and in line with the matching front panel hole. If you like, don't solder the legs at this stage as this can be done as the main PCB is being installed in the case, when the LED's final alignment can be checked. IR receiver chip U9 can be treated in a similar way.

Once the main PCB assembly is completed you can connect the power transformer as mentioned above, and perform a number of preliminary tests — see the section titled 'Testing' near the end of this article. On the other hand, it's probably more efficient to get on with the job of completing the other boards, and leave these checks until the final stages.

## Switch PCB assembly

The switch PCB (code 96pr12b) measures 158 x 35mm and holds the preamp's three selector switches: 'listen', 'record' and 'mode'. This should be put together in the usual low- to high-profile component order, starting with the resistor and two links.

You will need to fit three header strips to this board: two 16-way strips (8 x 2) for the incoming signals (indicated as 'A' and 'B' on the overlay) and one 20-way strip for the connection to the main board. As before, these lengths can be cut from a standard section of 25- or 40-way header strip, and the indicator LED (LED3, 'direct') should not be soldered in place until the switch PCB is being installed in the case.

If your sealed rotary switches are of the type that have a flat section on the shaft, you will need to consider the angle this faces when the switches are fitted to the board. This flat area is normally aligned with the knob grub screw, and you will need to check that the knob's pointer then lines up with the front panel artwork. Note that SW1 and SW2 can be fitted at two different angles, and SW3 at four.

A further potential for trouble here is that the pointer on some knobs is not positioned on the opposite side to the grub screw in the normal way — which can lead to further alignment problems. As this error can be both small or large, the best solution may be to mount each switch so that the flat area of the shaft is well away from the knob's grub screw, thereby avoiding potential alignment problems.

Once the three rotary switches are

mounted, you will also need to check that their position setting rings are in the correct slots. The rings can be found under the nut, and should be orientated so that the tab is in the correct switch body hole for its intended job — that is, position 6 for the 6-way 'record' and 'listen' switches, and position 3 for the remaining 'mode' switch.

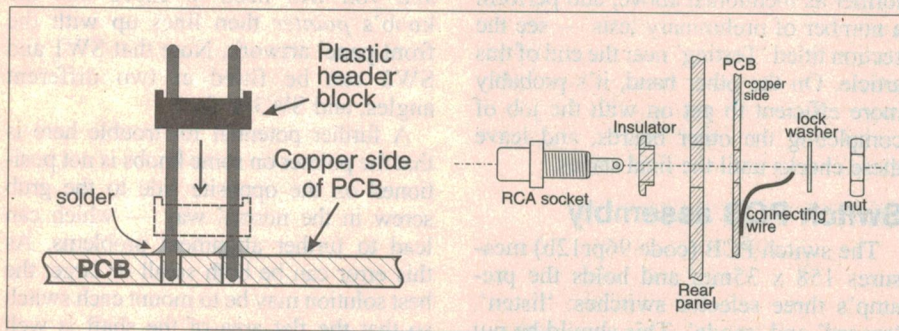
## Input PCB assembly

The arrangement of the input PCB is quite unusual, in that its components are fitted directly to the *copper* side of the board, as noted on the component overlay diagram. The board is coded 96pr12a, measures 275 x 33mm, and is ultimately held to the rear panel via the 16 input/output RCA sockets, which are in turn electrically connected to DIL header strips via the PCB tracks.

So in effect, the input PCB acts as a connector or interface, between the RCA sockets and the two IDC cables that pass signals to (and from) the switch PCB. The overall arrangement is quite easy to put together, and results in a very neat setup inside the preamp.

As you might expect, the two 16-way (8 x 2) sections of header strip ('A' and 'B' on the overlay) need to be fitted in a slightly unusual manner, as they are not normally installed from the copper side of a PCB. The method to use is depicted in Fig.3, which shows the header installed 'upside down' in the board, with the pins positioned just short of the non-copper surface.

The pins can then be soldered in place (as shown), and the plastic block slid down the pins until it contacts the solder or board surface — its new position is shown as a dashed outline on the diagram. The strip can then accept an IDC connector in the normal way, even though it has been installed in an 'inverted' position on the copper side of the board...



**Fig.3 (left):** Fitting the IDC header strips to the copper side of the input PCB.  
**Fig.4 (right):** How the RCA sockets and input PCB mate with the rear box panel.



**The main PCB mounts directly onto the box front panel via the pot shafts, while its audio signals are passed through a single 20-way cable.**

## IDC cables

Now that all of the main preamp modules are ready, the IDC ribbon cable can be cut into appropriate lengths and each section terminated in matching IDC sockets. Note that if you have (say) 25-way ribbon cable, you will need to trim two of the sections down to 16 wires and one to 20 wires. Also, if your cable has a coloured marking down one edge, remove the wires on the opposite side so that this 'tracer' can still be used to signify the 'pin-1' end of each IDC socket.

You will need to take a reasonable amount of care when fitting the crimp-style sockets to the cables, for a couple of reasons. One is that these sockets can only be (successfully) used once, so you should be very sure of their alignment and orientation to the cable before they are clamped together. Use a vice or dedicated crimping tool if possible, as the cable can be held more accurately in position this way.

The other aspect to consider is which way the cable exits from each socket, relative to pin one. This will ultimately effect the direction the ribbon cables run as they leave each board, so you will need to lay out the three PCBs in their approximate positions, then note the best orientation for each terminating socket. Pin one for each connector is marked on the overlay diagram and PCB artwork by the way, and this should always line up with the ribbon cable's coloured tracer.

Now that the preamp's main components are assembled, they can be installed in the case and the final wiring completed.

## Final assembly

Start the case assembly by fitting the input PCB as depicted in Fig.4. This is most easily done first, as the empty case will allow the best access to the RCA locking nuts and solder tags. Note that the body of each RCA socket is electrically connected to the PCB tracks via its nut and locking washer, so you will need to check that the board's copper layer is fully exposed at these points — use fine emery paper to clean each RCA's area, if necessary.

As you can see from the diagram, the sockets are electrically insulated from the metal chassis by plastic inserts which fit inside the matching panel holes. These shouldn't really protrude inside the box, and may need to be trimmed accordingly.

Insert the RCA/insulator combinations through the box panel and PCB as shown, then when you are confident of the overall alignment, progressively tighten the RCA locknuts. Use a multimeter to check that

all of the RCA bodies are indeed insulated from the metal box panel, and finally solder the connecting wires between the PCB tracks and RCA tags as shown. These short links can be formed with lengths of tinned copper wire, or just component leg offcuts.

Next, trim the pot and rotary switch shafts to match the knobs (if this wasn't done during the PCB assembly stages), and install the switch and main PCBs into the preamp's front panel.

The three IDC cables should be plugged into the switch PCB before it's attached to the chassis, while the 'direct' LED can be aligned and soldered after the board is locked in place. Conversely, both the main board's 'remote' LED and IR detector chip (U9) should be checked for alignment to their front panel holes, then soldered *before* that board is fully installed.

After that, the main board can be attached to the front panel via the pot shaft nuts. Note that the rear end of the assembly is supported by a bolt and small spacer, as shown, just behind the 'from switch PCB' connector on the component overlay diagram. Also, while we used a small section of PCB material to act as a spacer on the pot shafts (as can be seen in the preamp's interior shots), you can use normal flat washers for this, or just leave them out altogether.

The small amount of 'loose' wiring in the preamp can now be completed, starting with the connections to the main PCB assembly. And by the way, note that while we mounted the headphone socket on a small bracket rather than directly to the front panel, this was only to hide its rather large chrome lock nut.

The headphone socket and 'mute' LED can be wired to their pins on the main board via a six-way length of IDC cable, as we've done in the prototype. Refer to the component overlay for these connections, and use a multimeter to double check the pins on the headphone socket itself.

Note that the socket should have a set of normally closed contacts, one of which must be linked to ground via the socket's own ground pin (GND) while the other is wired back to the 'SW' pin on the main board. This pin is used to disable the muting relay, and is normally held at ground potential via the headphone socket switch.

Two lengths of shielded cable can now be connected between the main and input PCBs, as shown in their respective overlay diagrams ('LOUT' and 'ROUT'), and finally the AC mains wiring completed as shown in Fig.5. As usual, take particular care with the 240V mains part of this, and fully cover any exposed connections with varnished cambric or heatshrink sleeving.

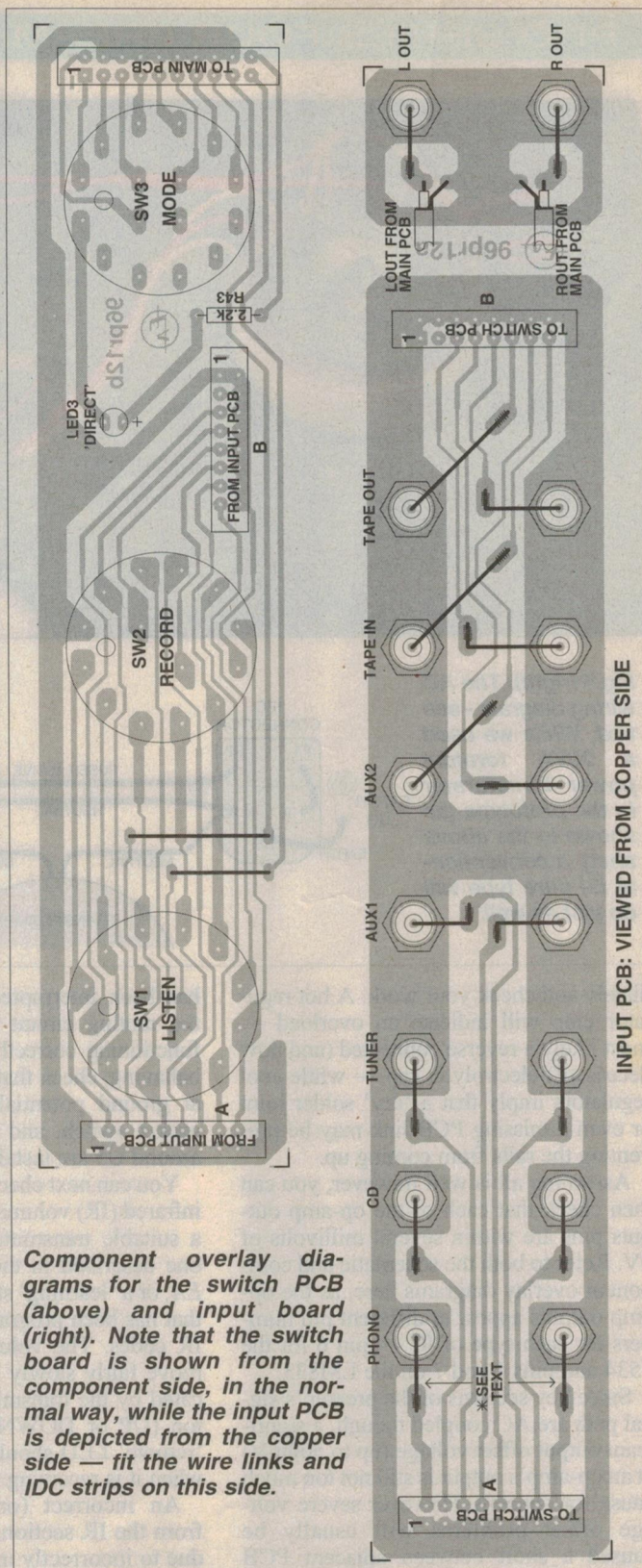
As shown in the diagram, the mains IEC connector's earth pin is wired directly to a solder lug which is in turn bolted to the chassis via one of the IEC connector's mounting screws. This contact should be both firm and electrically reliable, so the chassis must be cleared of all paint or anodising at this point, and a locking or 'star' washer used under the nut.

Also shown are small wires protruding next to two of the power switch lugs. These leads are the connecting wires for the internal neon indicator lamp, and can be used as a guide for the switch orientation and connection points. Note that the 'switched active' and 'neutral' wires are soldered to those lugs.

Once you are satisfied that the mains wiring is correctly and safely installed, the transformer can be bolted in place (not too tight!) and its secondary winding leads connected to the main board, as shown in the component overlay diagram. Then double check that all wires and sockets are installed correctly (note the orientation of each IDC connector), and the preamp powered up for the initial tests.

## Testing

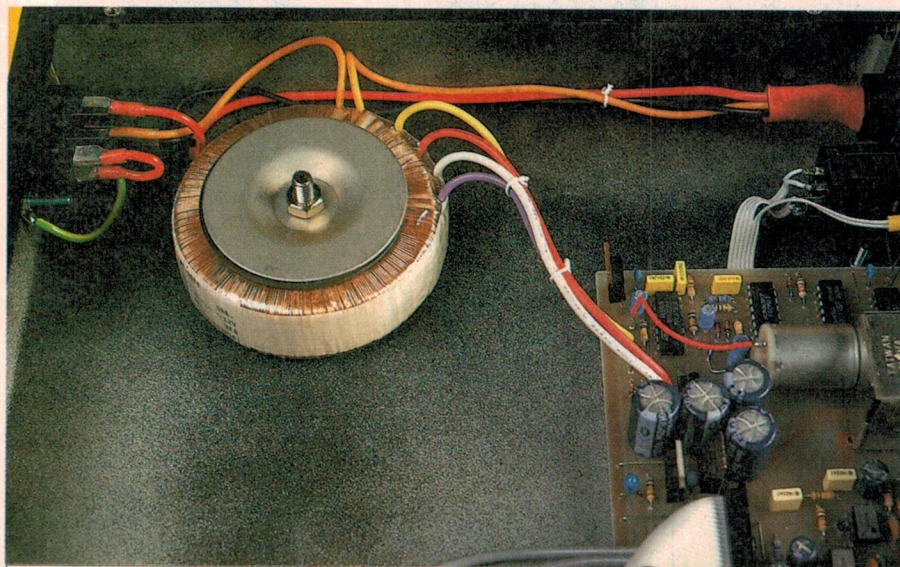
The first step here is to check that the main power supply rails are at close to their specified levels. If you take care not



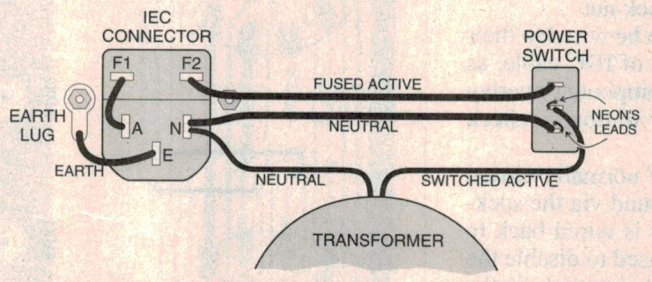
**Component overlay diagrams for the switch PCB (above) and input board (right). Note that the switch board is shown from the component side, in the normal way, while the input PCB is depicted from the copper side — fit the wire links and IDC strips on this side.**

to inadvertently apply a short between adjacent IC pins, this is most easily done by probing pins 4 (-12V) and 7 (+12V) of op-amp U4, and say pin 14 (+5V) of the 556 timer U13. You can also check the decoupled V+ and V- rails (approx +/-11V), by monitoring pins 8 and 4 (respectively) of U3, and the Vcc supply (around 4.5V) at pin 16 of U11.

If one of the main voltages is missing or low, switch off imme-



**Fig.5 (right):** The AC wiring diagram - see text. While we used a 20VA toroidal power transformer in the prototype (as shown in the above shot), a conventional E-I core type will do just as well.



diately and check your work. A hot regulator chip will indicate an overload — most likely a reverse connected (and now deceased!) electrolytic cap — while cool regulators imply that a 'dry' solder joint or even a missing PCB link may be preventing the rails from coming up.

Assuming all is well however, you can then check that each of the op-amp outputs pins are within several millivolts of 0V. Refer to both the schematic and component overlay diagrams here, as the op-amp outputs appear at different pin numbers for each type of IC — pin 6 for the 5534 and pins 1 and 7 on the LM833.

Since key sections of the preamp's signal path are AC coupled though, a significant output offset voltage (up to 500mV) at an op-amp's output is still not too much cause for concern. However severe voltage offset problems will usually be caused a short between adjacent PCB tracks, incorrect resistor values or ICs installed the wrong way around.

Other than that, a second or two after power is applied to the preamp you should hear a quiet 'click' from the muting relay, at the same time as the 'mute' indicator LED turns off. This should happen regardless of how briefly the power

has been interrupted, and indicates that the muting circuit based around U5 is functioning correctly. If the relay is not behaving, check that the 'SW' pin is held at ground potential via the headphone socket switch, and the key components around U5 are installed correctly.

You can next check the operation of the infrared (IR) volume control system, with a suitable transmitter unit — either the one described in the July 1996 issue of *EA*, or a 'learning' style of remote control that has been programmed with the same IR codes. The volume pot shaft should move fairly slowly in the direction indicated by the transmitter's command button (UP or DOWN), and the preamp's 'remote' LED should pulse continuously when it is receiving valid IR codes.

An incorrect (or lack of) response from the IR section is again most likely due to incorrectly installed components, and in this event you will need to closely check your work against the component overlay diagram. If the LED responds but the pot motor does not, U5 and its associated components and wiring will be under suspicion. On the other hand, a lack of activity from both the LED and the motor will indicate a

problem around U9 to U11.

With these basic checks out of the way, you can apply normal audio signals to the preamp and monitor its output with a power amp or set of headphones. Starting with the mode switch in its 'direct' position (LED2 on) you should find that signals pass through to the output at around their original level (that is, with an overall 'gain' of about 0dB), and the 'listen' switch and volume control act as you would expect.

If you run into trouble here, remember that there is no active circuitry in the *main* signal path when the preamp is in its 'direct' mode. So a lack of signal at the output (say) will indicate a connection problem — most likely a reverse-connected ribbon cable. Note that if you are monitoring the preamp's output with headphones, you will need to be sure that the headphone amps (U4 and U104) are working correctly before blaming the inter-board connections.

Once you are happy that the direct mode is functioning correctly, move the mode switch to the 'bypass' position and note that the output level increases by a significant degree (around 12dB). Since op-amps U2/102 are now in circuit, a problem here will be due to an error in that part of the circuitry.

The preamp's operation in the 'tone' mode can now be judged in a similar fashion. When this is selected, there should be no real change in the output signal except that the tone controls will now effect the sound. Again, since you have progressively worked through the preamp's three modes, a problem here must be due to the circuitry around op-amp U3.

By the way, we should also point out that we have elected *not* to join the circuitry's common (0V) point to the chassis in this design. While the chassis must be directly connected to the mains safety earth as shown, the actual circuitry is effectively 'floating' until tied to ground via the power amp and/or input signal leads. This approach eliminates the possibility of signal earth loops and the associated noise intrusion, and is common practice with test instruments and sensitive audio equipment.

Because of this however, you may find that there is a degree of 100Hz hum heard through the headphones when the preamp is *not* connected to the power amp or an earthed signal source. While this situation may occur during initial testing, it will not be the case when other audio equipment is connected — that is, during normal use. To avoid the

problem while checking the preamp with headphones only, just connect a clip lead between the circuit ground (0V) and the chassis.

## Optional phono preamp

The phono preamp board, should you elect to use it, mounts directly to the input PCB at the phono RCA connectors. In this way, the low-level phono signals pass to the preamp board over the shortest possible distance, and therefore with the least risk of picking up external interference. In terms of the signal path, the phono preamp simply replaces the link that normally passes between the (phono) RCA connectors and the input PCB.

All of the phono preamp parts mount on to a small PCB measuring 57 x 36mm and coded 96pr12d, and these should be fitted in the usual low-to-high-profile order while referring to the matching component overlay diagram. We would recommend using PCB pins for just the power supply connections (+12V, -12V and 0V), since the signal connections at the other end of the board are soldered directly the RCA plugs or tinned copper wire.

This arrangement is depicted in Fig.6, which shows the phono end of the input PCB (looking from inside the box), and the edge-on view of the phono PCB in its final mounting place — the copper side is facing towards the left.

Note that the phono board's Lin (left in) and Rin (right in) pads are soldered directly to the (phono) RCA socket lugs, while the output and ground pads for each channel connect to the input PCB via short lengths of tinned copper wire, as shown. By the way to gain a little more access to these points, you can temporarily unplug the nearby IDC connector ('A').

## PRO SERIES FOUR PREAMPLIFIER — PARTS LIST

### Resistors

R1,101	50 ohms
R2,102	80k
R3,103	68k
R4,104	3.9k
R5,8,19,105,108,119	47k
R6,106	39 ohms
R7,107	82 ohms
R9,22,29,30,109,122	150k
R10,21,110,121	1k
R11,24,34,111,124	2.2k
R12,112	680 ohms
R13,14,17,113,114,117	27k
R15,16,23,115,116,123	4.7k
R18,27,28,118	56k
R20,120	100 ohms
R25,125	220 ohms
R26,126	100k
R31	180ohms
R32,44	1.8k
R33	47 ohms
R35,36,37,38	68 ohms
R39	1M
R40	22k
R41	39k
R42,45	2.7k
R43,46	560k
RV1	20k dual mini pot, log, 5V motor drive
RV2	100k dual mini pot, linear
RV3	25k dual mini pot, linear

### Capacitors

C1,101	47uF 16V electro
C2,102	100pF ceramic
C3,103	220uF 16V electro
C4,104	18nF MKT
C5,105	68nF MKT
C6,11,16,106,111,116	22uF bipolar
C7,107	0.22uF MKT
C8,15,108,115	220pF ceramic
C9,109	2pF ceramic
C10,110	1nF MKT
C12,18,112	10nF MKT
C13,14,36,114,115	4.7nF MKT
C17,117	470pF ceramic
C19	22uF 16V electro
C20,21,22,23	1000uF 25V electro
C24,33,35,37	0.1uF monolithic
C29,31,38,39	0.1uF MKT
C25	10uF 16V electro
C26,27	2.2uF 16V electro

C28,30,32,34

100uF 16V electro

C40,41

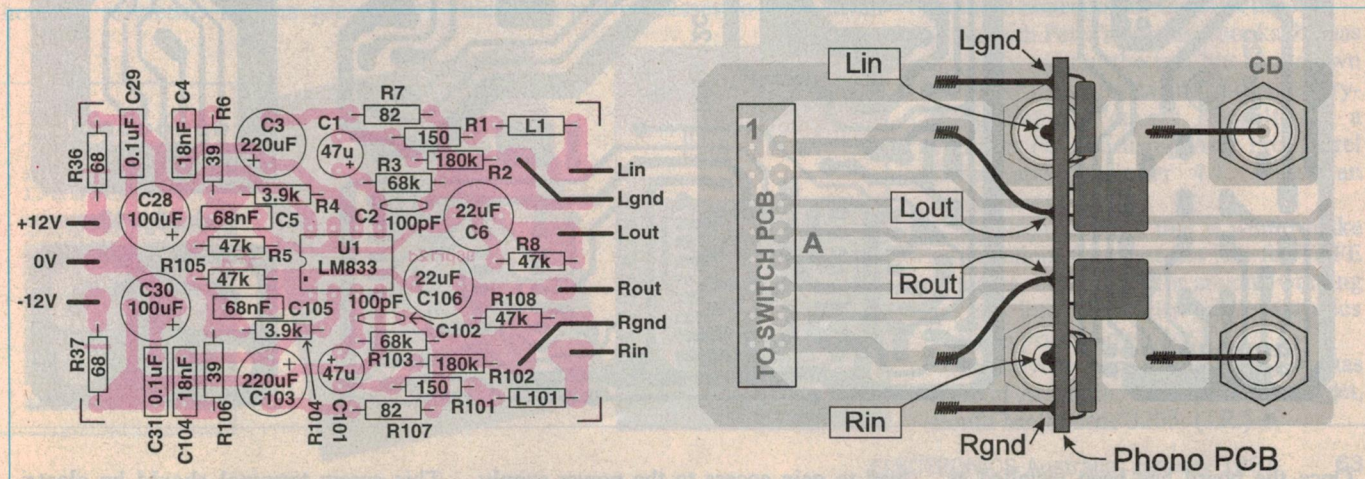
4.7uF 16V electro

### Semiconductors

U1,3	LM833 dual op-amp
U2,4,102,104	NE5534 op-amp
U5,13	556 dual timer
U6	7805 +5V regulator
U7	7812 +12V regulator
U8	7912 -12V regulator
U9	IR Receiver IC Sharp F1U60 or similar
U10	4060 counter/oscillator
U11	4017 decade counter
U12	4011 quad NAND gate
Q1	BC338 NPN transistor
LED1,2,3	3mm LEDs: red, green and yellow
D1,2,8,9,10,11,12	1N914 diode
D3,4,5,6,7	1N4002 power diode

### Miscellaneous

L1,L101	Coil on F29 bead: 8 turns 0.25mm ECW
SW1,2	2 pole, 6 position sealed rotary switch
SW3	4 pole, 3 position sealed rotary switch
SW4	Mini rocker switch, mains-rated, illuminated
T1	24V (or 30V) centre tapped transformer, 5VA or more
RLA	DPDT 12V relay, 200 to 300 ohm coil
3 x 22mm brushed aluminium knobs	
3 x 16mm brushed aluminium knobs	
1 x 6.3mm stereo socket - insulated, switched	
16 x metal chassis RCA socket	
16 x plastic insulating kits for above RCA sockets	
1 x IEC male chassis-mount 240VAC plug with fuse	
6 x dual in-line jumper/header strip	
4 x 16-way IDC line socket	
2 x 20-way IDC line socket	
16-way and 25-way IDC cable	
single screened audio cable	
light-duty and mains-rated hookup cable	
metal box,	402 x 257 x 48mm (dimensions not critical)
Main PCB:	96pr12c, 161 x 89mm
Switch PCB:	96pr12b, 158 x 35mm
Input PCB:	96pr12a, 257 x 33mm
Phono PCB (opt):	96pr12d, 57 x 36mm



The component overlay and installation diagram for the optional phono preamp stage. As you can see, the small PCB mounts directly onto the 'phono' input RCA sockets, while the ground and output connections are made with small wire links

## Construction Project:

# COMPACT, LOW COST PC-BASED DAQ MODULE

Here's the design for a very compact and low cost module which allow virtually any PC to be used for quick and easy data acquisition and control. It connects to any standard parallel printer port, and despite its tiny size provides eight analog inputs, four digital inputs and four digital outputs — all controlled from the PC using matching software.

by PETER SIMMONDS

Martin Luther King once said "I have a dream", but his dream and mine were markedly different. My dream was to produce a data acquisition and control unit for an IBM compatible PC. It had to be so small that I could carry it around in my pocket, like one of those dongles you put on the back of a PC. It had to use the serial port or the parallel port, so I could use it on my desktop or my portable PC without having to open the computer's case.

It was also to be manufactured using normal dual-in-line ICs, not surface mounted IC's, and it would be powered from the PC. The ADC used in it had to have 12-bit resolution, more than one analog input — and what's more, I wanted to have both digital inputs and

digital outputs.

'In your dreams', I was told, but after some agonising I have made that dream come true. Well, almost true: I couldn't power it from the PC. Although it is externally powered the unit still has very low power requirements and can be powered by a plug pack or a 9V to 12V battery, thus making it suitable for portable situations.

I started off with one of those DB25 'Gender Changer' hoods, which I had picked up from a Jaycar store some months before. Its small size and price made it perfect for the job, but it meant every component used had to earn its place or it was out. There would be very little 'fat' in this design. Also all external digital and analog I/O signals had to

come in through a DB25 connector.

After a bit of brain rattling, the serial port on the PC was ruled out because I would have had to use a small microprocessor. So that left only the parallel port.

I had liked the look of the Maxim MAX186 when it was released by Maxim a couple of years ago. It was slimmer, and had more slender and elegant legs than the others. (Oops, I must stop breathing in those solder fumes!) What made this ADC so suitable was that it operated using a serial bus instead of a parallel bus. This meant less space was required on the PCB because of its smaller size — there wouldn't be so many tracks and not so many lines from the parallel port would be tied up controlling it. It also had a fistful of features, such as:

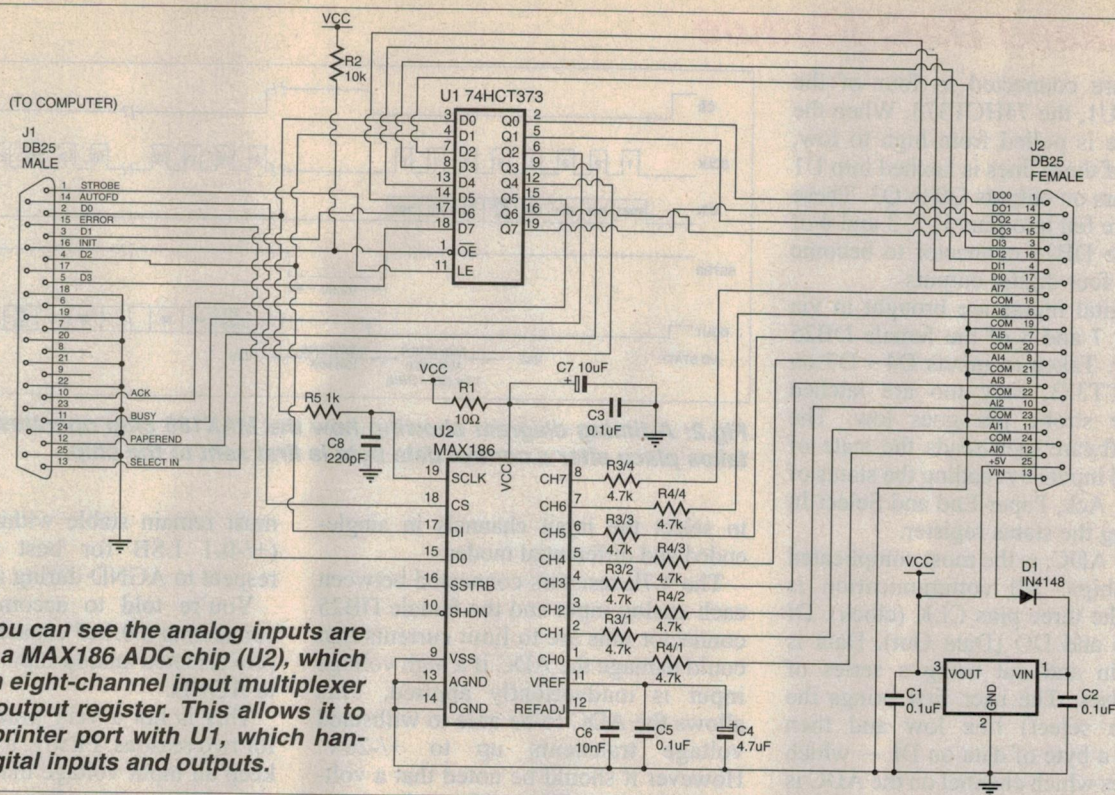
- An internal analog multiplexer that could be configured for eight single-ended inputs or four differential inputs.
- An internal voltage reference;
- A read input voltage range of 0 - 4.096V;
- 12-bit resolution;
- A conversion time under 10 $\mu$ s (it's no slacker);
- A CMOS design with low power requirements;
- It requires a only a few external capacitors to filter noise from the power supply and provide compensation; and
- It was economically priced.

The only extra components I had to add was a resistor on each analog input to protect it against current overload, if a high voltage was inadvertently connected to it.

The next decision was to use a 74HCT373 for the digital I/O. This 8-bit



*The author's prototype for the DAQ module, shown here a little larger than actual size. It's built inside a DB-25 'gender changer' backshell, yet provides no less than eight analog inputs, four digital inputs and four digital outputs.*



**Fig.1:** As you can see the analog inputs are provide by a MAX186 ADC chip (U2), which includes an eight-channel input multiplexer and serial output register. This allows it to share the printer port with U1, which handles the digital inputs and outputs.

latch is available everywhere, its cheap and it is able to sink and source a reasonable amount of current. I could use four of the latches for the inputs and the other four for the outputs.

Because I was using the parallel port, there was no way I could power the digital outputs from the parallel port. Hence it meant that the unit had to be externally powered. That in turn meant I had to fit in a voltage regulator — so a plug pack, battery or other type of supply could be used.

## A PC's parallel port

The circuit diagram in Fig.1 shows the pins on the parallel port, at far left (J1). It is probably best if a short description of the parallel port is given. A more detailed description was given in *EA* for June 1995. A PC can normally have up to two parallel ports, 'LPT1' and 'LPT2', with the I/O base addresses shown in Table 1.

Each parallel port has three registers: a data register, a control register and a status register. The address of the data register is the base address, while the status register occupies the (Base address + 1) and the control register (Base address + 2). For LPT1 the addresses of the data, status and control registers would be 378H, 379H and 37AH respectively.

Each register is able to control or read the status of a number of the parallel port's lines. This information is listed in Table 2.

The parallel port's data register was originally designed to be 'write only', but in recent times most computers have been designed with the parallel port being bidirectional — hence it is both read and write. However to make this data acquisition unit operate with all types of PCs, the data register is used only as a write register. When you write a byte of information into the data regis-

**Table 1 — Base Addresses**

Parallel Port	Address
LPT1	378H
LPT2	278H

ter it appears on the lines D0 to D7 as shown in Table 2.

The control register is again a write-only register. By writing a byte of information to this register you are controlling the printer 'handshake' lines Select, Init, AutoFeed and Strobe.

The final register is the status register, which is a read-only register. By reading

this register you read the status of the handshake lines Busy, Ack, Paper End, Select In and Error.

## Circuit description

Let's start off with the humble power supply. Power is fed into the unit via pins 13 and 24 of the female DB25 connector J2. Diode D1 is there to prevent damage if the user mistakenly reverses the connections. The voltage regulator is a 78L05, which converts the supply voltage to +5V. The +5V output is connected directly to the 74HCT373, but is filtered by resistor R1 and capacitor C1 before supplying the MAX186 ADC chip.

The +5V is also connected to pin 25 of the female DB25 connector. This allows the user to power external components such as pull-up resistors, when sensing the state of relays or switch contacts.

The 74HCT373 is enabled and disabled by the Init pin on the parallel port. To enable the device this line must be pulled low.

The data lines D0 to D3 on the paral-

**Table 2 — Parallel Port Registers**

Register	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Data	D7	D6	D5	D4	D3	D2	D1	D0
Status	Busy	Ack	Paper	Select	Error			
			End	In				
Control			Output	IRQ	Select	Init	AutoFd	Strobe
			Enable	Enable				

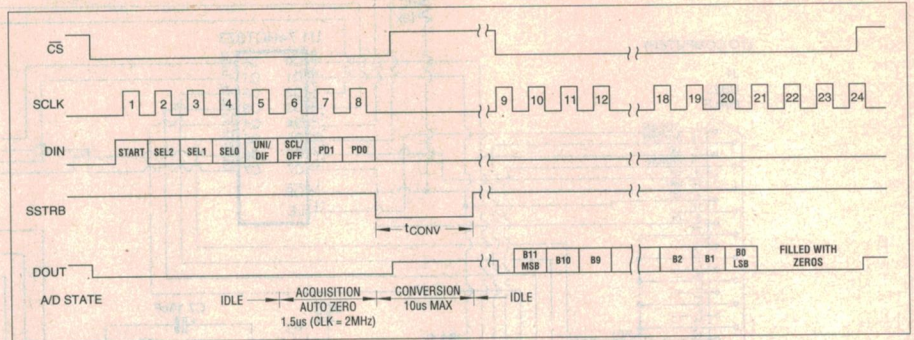
## PC-based DAQ Module

lel port are connected to four of the inputs of U1, the 74HCT373. When the strobe line is pulled from high to low, the state of these lines is latched into U1 and appears on outputs Q0 to Q3. These outputs are fed into pins 1, 2, 3 and 4 of the female DB25 connector to become the unit's four digital outputs.

The digital inputs are brought in via pins 5, 6, 7 and 8 of the female DB25 connector. Taken to inputs D4 - D7 on the 74HCT373, they too are latched when the strobe pin goes low. The user's software then reads the state of the digital inputs by reading the status of the Busy, Ack, Paper End and Select In pins, using the status register.

U2, the ADC, is the most complicated of the chips. All communication is through the three pins CLK (clock), DI (Data In) and DO (Data Out). Data is clocked in and out using a series of clock pulses. The user first brings the CS (chip select) line low and then clocks in a byte of data on DI — which configures which channel on the ADC is to be read, whether the reading is to be single ended or differential, and whether the reading is to be unipolar or bipolar.

The user then waits approximately 10 $\mu$ s for the ADC to finish its conversion, and then provides 12 clock pulses in order to read the ADC output on the DO line. A diagram of the process is shown in Fig.2. Table 3 shows the significance of the control byte fed to the MAX186 to configure its operation, while Table 4 shows how the SEL2, SEL1 and SEL0 bits are used



**Fig.2: A timing diagram showing how the MAX186 chip operates. Conversion takes place after a control data byte is first sent to the chip.**

to select the input channels in single-ended and differential modes.

The 4.7k resistors connected between each analog input and the female DB25 connector pins are to limit currents that could damage the ADC if a high voltage input is inadvertently applied. This allows the ADC to be able to withstand voltage transients up to  $\pm 20$ V. However it should be noted that a voltage higher than 5V on any one input can affect the readings on the other inputs.

I had a problem with differential readings, in that at some areas within the ADC's range (e.g., around 1024 and 2048) it was showing an error of 20mV. Reading through the specification sheet I noticed Maxim states that when the ADC is carrying out a differential reading it uses a 'pseudo-differential' configuration, in that only the signal at the IN+ is sampled. The return side (IN-)

must remain stable within  $\pm 0.5$  LSB ( $\pm 0.1$  LSB for best results) with respect to AGND during a conversion.

You're told to accomplish this by connecting a 0.1 $\mu$ F capacitor from AIN- (the selected analog input, respectively) to AGND.

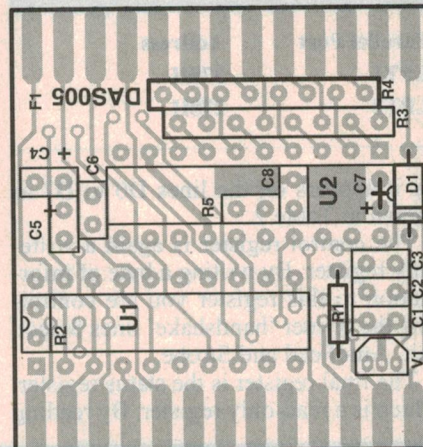
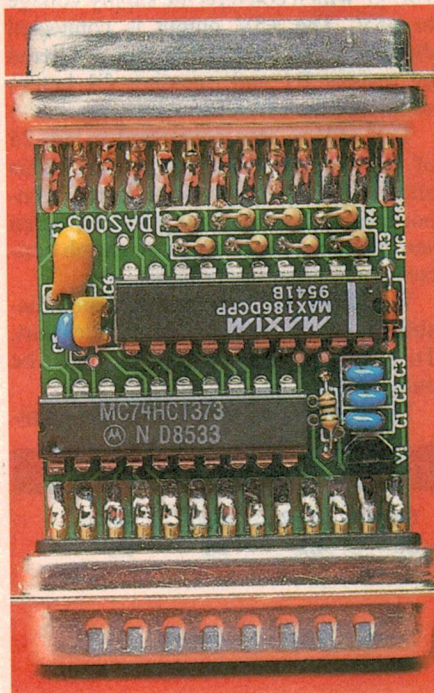
This is not a very practical situation for two reasons. Firstly, it is very hard to keep an input voltage that stable and in any case some voltage sources don't handle a 0.1 $\mu$ F capacitor on their output very well (they can oscillate and do other weird things). Secondly when measuring differential inputs, the magnitude of the positive input may be less than the negative input — hence you would expect the ADC to return a negative reading. In this situation the MAX186 just returns a '0'.

Because of this I have written the software so that when the user requests a differential reading, it actually does two consecutive single ended readings and then subtracts the readings. The problem with this method is that differential readings cannot be applied to high speed signals.

### Construction

Remember throughout the construction that there is very little 'headroom' for the components when the DB gender changer hood is put into position. So make sure all of your components are small (the very small 1/4 watt resistors from Jaycar are perfect), and mount them as close to the board as possible. As you are fitting in the components it's a good idea to test that the hood will still fit in place before soldering.

The first step is to push the solder type 25-pin male and female D connectors on to the ends of the PCB board. Make sure you have the male connector at the end closest to the voltage regulator. Solder them into position. Note that in order to fit all of the components on to the board, a few of them have to be mounted on the



*At left is a closeup of the prototype DAQ PCB, again just a little larger than actual size. The PCB overlay is shown above, for reference. Not surprisingly, there isn't a great deal of spare space — it's a fairly crowded little board, and care needs to be taken during assembly.*

bottom side. These components should be soldered into place first.

Turn the board over with the bottom side up and solder into position C7, C8, R2 and R5. Note the tantalum cap C7 will be bending over slightly, and C8 (220pF) should be small in size. When the legs are trimmed make sure they are cut as close as possible to the board.

Next turn the board with the top side up and solder in the rest of the capacitors and the resistors. R3 and R4 are SIL resistor arrays with four 4.7k resistors. Note that the tantalum capacitor C4 will again be bending over slightly. The final step at this stage is to mount the voltage regulator and the diode, making sure they are orientated correctly before soldering.

Leave the 74HCT373 and the MAX186 chips out of the unit until we have tested the +5V supply.

## Testing

To test the unit, first make up an input lead with a male DB25 connector fitted, with the connections as shown in Fig.2. Plug this onto the female input connector of the unit.

Do not connect the device to your PC port as yet. Instead carry out a final check to make sure all components such as tantalum capacitors, the diode and voltage regulator are correctly aligned.

Switch on the power to the unit and quickly check with a DVM that +5V is present between the pads for pins 20 and 10 on the 74HCT373. If this isn't the case there is something wrong with the regulator.

If you have got +5V, switch off the power and then solder in the 74HCT373 and the MAX186, making sure they are orientated correctly. I'm sorry there is no room for IC sockets with this unit. Now reapply the power and check the +5V again.

If everything is OK, switch off the power and connect the unit to the PC's parallel port. Switch on the PC and then the power to the data acquisition unit. Now run the DOS program LIBDAS5.EXE. This program reads all the

Table 3 - MAX186 Control Byte		
Bit	Name	Description
7(MSB)	START	The first logic "1" bit after CS goes low defines the beginning of the control byte
6	SEL2	These three bits select which of the 8 channels is used for the conversion
5	SEL1	
4	SEL0	
3	UNI/BIP	1=Unipolar 0=Bipolar Can only be unipolar for this design as a bipolar power supply is required for Bipolar readings
2	SGL/DIF	1=Single Ended, 0=Differential
1	PD1	Select clock and power down modes PD1=1 and PD=0 for Internal Clock mode.
0(LSB)	PD0	

analog inputs, digital inputs and outputs. You can now inject voltage signals to the analog inputs and read them, read the status of the digital inputs and watch the digital outputs being activated.

## The software

For those who wish to write their own programs, I have provided functions written in Borland C, QuickBASIC and Visual BASIC. Source code for these functions is provided. Sample programs (LIBDAS5.C and LIBDAS5.BAS) using the functions are included. Both these programs read all the analog and digital inputs and operate each of the digital outputs. Because of space restrictions in this article the source code and executables for these functions are not shown, but are available on EA's Computer BBS — (02) 9353 0627.

For those people who want quick ease of use, we have produced a Windows program called I-SEE, which will run under Windows 3.1 or Windows 95. Written in Visual BASIC, this program allows the user to easily set up the data acquisition unit to view the analog and digital inputs, control the digital outputs as well as collect readings of temperature, pressure, the digital inputs and log them to disk.

In summary, I-SEE allows the user to:

- View the status of the digital inputs;
- Control the status of the digital outputs;
- View the analog inputs. The readings can be viewed and logged as 'raw' readings of 0 - 4096, or they can be scaled to engineering units: e.g., 0 - 100°C or 0 - 1000kPa;

Table 4- MAX186 Channel Selection				
SEL 2	SEL 1	SEL 0	SE Channel	Diff Channel
0	0	0	0	0+ 1-
1	0	0	1	1- 0+
0	0	1	2	2+ 3-
1	0	1	3	2- 3+
0	1	0	4	4+ 5-
1	1	0	5	5+ 4-

- Display the analog inputs on graphs or trends. The user has access to four graphs and on each of those graphs the user can plot any four analog inputs;
- Having an inherent accuracy of +/- 3mV, the unit can easily be calibrated for more accurate tasks; and
- Log or store the analog input and digital input readings to a file on your hard disk or a floppy disk.

The logging of data to disk has the following features:

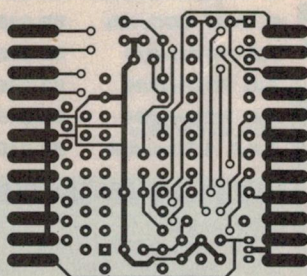
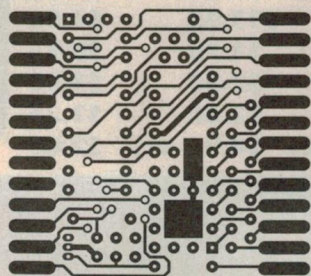
1. The period between readings can be varied between 1 and 32767 seconds;
2. The data is stored in comma-delimited format, allowing the user to load the data into an Excel or Lotus 123 spreadsheet easily — where it can be manipulated, graphed and reports made;
3. Storage of data can be initiated and stopped by the user clicking a box on the screen, or the user can program data storage to commence and end when a nominated digital or analog input reaches a set value.

The I-SEE program is supplied by Ocean Controls with the DAQ module or PCB — see the next section. Note that the source code for I-SEE is not included; only an executable.

## Module or PCB available

The Data Acquisition and Control unit is available as a complete module, including all software, from Ocean Controls, of 4 Ferguson Drive, Balnarring 3926; phone (059) 83 1163. The complete module with software is priced at \$120. Alternatively just the PCB and software are available, for \$45.

Ocean Controls also has a DB25 connector to screw terminal interface board, available to allow easy connection to the Data Acquisition Unit. This can either be mounted in a jiffy box or on spacers. ♦



The etching patterns for both sides of the DAQ module PCB, reproduced here actual size for those who like to etch their own.

# JAYCAR JANUARY SALE

## ALUMINIUM CASE WITH FOAM

This case has a foam insert which has been perforated into 15mm square holes. Simply pull out the squares and form a hole to put your valuables equipment in. The lid also has a foam insert for complete protection. Ideal for carrying your camera or video equipment, or even wine and glasses! Case is lockable and two keys are supplied. Case is the same size as our economy attache case. Size 450(W) x 320(H) x 125mm(D).

Cat. HB-6356

**\$69.50**

## RESISTOR STORAGE TRAY

Brand new model for 1997. Now with 88 compartments! (The old model had 36). Enough to hold one of our RR-1697 resistor packs (10 of every 1/4w from 1Ω to 10M). Each compartment will hold 40 resistors if they are not banded. If banded, they form a friction fit with the ends of the cell and will not fall out. Now with lid. Also included is a clear slide on lid, that keeps all the goodies in their place. Size 420mm(L) x 275mm(W) x 13mm(D). Compartment size 60mm(L) x 16mm(W) x 8mm(D). An excellent low cost way to store resistors, capacitors, transistors, diodes, nuts, bolts, buttons etc., etc., etc.

Cat. HB-6342

**Only \$11.95**

## SURROUND SOUND SPEAKERS

These speakers are ideal for Dolby surround sound systems, as well as wall speakers for general stereos! They incorporate a unique swivel bracket that allows them to be pointed directly down to the listening area.

Speakers inside are a 4" woofer with large 5.3oz. magnet and 1" dome tweeter. White colour to suit most houses. **Specifications** •Power handling-25 WRMS •Frequency response-20Hz-20kHz •Impedance-6ohms •Woofer-4" 5.3oz magnet •Tweeter-1" dome •Colour-White •Size-220mm(W) x 240mm(H) x 130mm(D).

Cat. CS-2520

**\$99.00 Pair**

## 1.3AH SUB "C" BATTERY

Sub C batteries are commonly used in RC racing cars & power drill battery packs. Supplied with solder tabs.

Cat. SB-2456

**Were \$6.95**

**Now \$4.95 ea Save \$2**

## NEW MICROTAC BATTERIES

SLIM NI-MH 900 MAH

Only 12mm thick Cat. SB-2569

**\$79.95**

JUMBO 2100 MAH NI-MH

Cat. SB-2581

**\$49.95**

**FREECALL FOR PHONE ORDERS 1800 022 888**

## DIGITAL HYGROMETER

Two displays, one reads the temperature, the other relative humidity. It also records the minimum and maximum temperature and humidity. See 96 catalogue, page 171 for full details.

Cat. QM-7200 **Was \$49.95**

**Jan \$35 Save \$14.95**

## ULTIMATE REMOTE CONTROL

This must be the ultimate remote control! It is a learning remote control and will operate up to 8 pieces of equipment. It is quite unique in as much as it has a different LCD display for each piece of equipment its controlling. For example, the VCR mode displays the typical VCR functions and when switched to the TV, the TV controls appear on the screen. And, if you don't want all the functions on a display, you can simply delete what you don't want. There are 28 programmable visual keys for each individual component. You can teach any command key, any function in each of the 8 devices. The 8 functions are: TV, VCR, CD, LD, AMP, Tuner/Taper, Sel1, Sel 2. Sel 1 and 2 are spares - so if you have two VCR's for example you simply programme sel 2 for the 2nd VCR. An amazing piece of equipment, that is well worth the asking price.

Cat. AR-1720

**Only \$179.50**

## ALARM SATELLITE SIREN AND STROBE

This is a micro-processor controlled alarm device with

siren, strobe, back up battery and tamper switch combined in one unit. A unit such as this is an important part of a home burglar alarm because, if the burglar alarm or siren is tampered with or disabled, this module will sound under its' own battery power, so you still have some protection. You can use this unit instead of buying the usual - metal box, strobe and speaker.

**Features:** •If triggered, strobe can be wired to continue flashing, so you instantly know alarm has been triggered. •High siren output at 116 dB / 1M. •Double strobe tubes for extra visibility •Selectable siren sounding time. •Rechargeable battery circuit. •Double tamper circuit - detects when wire is cut, or box is opened or moved. •Built in LEDS advise you of panel power failure, as well as tamper and battery charge mode •Easy installation. •Polycarbonate housing which is fire-resistant, impact resistant and heat-resistant. **Specifications:** •Power supply - 12V DC from alarm panel •Back up battery - 9.6V 300mA NiMH •Current drain standby 20mA max., operating 300mA max. •Tamper contact - NC relay contact 1A at 24V •Size - 206(H) x 146(W) x 65(D)mm. •Strobe colour - Blue

Cat. LA-5305

**\$89.50**

## POCKET DMM'S REDUCED

**MANUAL**

3.5 digit, wrap around leads, small size, one hand operation, continuity buzzer, diode test.

Cat. QM-1520

**Was \$34.95**

**Now \$26.95**

**Save \$8.00**



**AUTORANGE**

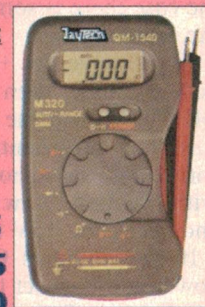
3.75 digit, data hold 3999 count, wrap around leads, small size, one hand operation, continuity buzzer, diode test.

Cat. QM-1540

**Was \$49.95**

**Now \$39.95**

**Save \$10.00**



## SAVE BIG \$\$\$ ON NICADS

DESCRIPTION	CAT #	WAS	NOW	SAVE
D Size 1.2AH	SB-2460	\$5.95	\$3.95	\$2.00
C Size 2.25AH	SB-2464	\$9.50	\$6.50	\$3.00
9 Volt 100mA	SB-2458	\$17.95	\$13.95	\$4.00
AA 550MAH	SB-2452	\$2.50	\$1.75	\$0.75
AA 720MAH	SB-2450	\$3.50	\$2.50	\$1.00
AA 720MAH with solder tabs	SB-2451	\$3.75	\$2.50	\$1.25
AAA 180MAH	SB-2454	\$6.95	\$4.95	\$2.00



## 30 PIECE ENGINEER'S DRIVER SET

Kit includes:

• 5 slotted bits 0-1, 3-4, 5-6, 8-10, 12 • 5 hex bits 3/32", 5/64", 7/64", 1/8", 9/64" • 4 Phillips bits No 0, 1, 2 & 3 • 4 square recess bits No 0, 1, 2 & 3 • 6 Torx bits T10, T20, T25, T30, T40 • 2 Pozidrive bits No 1 & 2 • 1 x 1/4" drive socket adaptor • 1 x 1/4" drive hex bit holder And it's all housed in a sealable tough plastic case.

Cat. TD-2000

**Was \$12.95**

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## MULTIFUNCTION ELECTRICAL AND ELECTRONIC TESTER

It does the following: •AC voltage test - contact method from 70-250VAC or non contact from 70-10,000VAC •DC voltage test - up to 250VDC •Continuity test •Polarity check - 1.2 to 36VDC •Microwave oven leak detector check •Wrong mains connection check •Capacitor check •Diode check •Transistor check •Ignition check •Globe / relay / fuse / speaker / speaker check •TV / monitor static radiation check Cat. TD-2050

Was \$9.95 Jan \$7.50 Save \$2.45



## 1" HIGH FREQUENCY COMPRESSION DRIVER SELLOUT

This driver exhibits a wide, smooth frequency response with low distortion and SPL of 102dB 1W/1M. Impedance 16Ω, power handling 35WRMS sine wave above 1500Hz. See 96 catalogue, page 50 for full details. Limited quantity available.

Cat. CT-1950 Was \$119 Now \$89 Save \$30



## HORN FOR COMPRESSION DRIVER

120 X 90° exponential horn. Made from ABS.

Size 318(W) x 198(H) x 211(D) mm. See 96 catalogue, page 50 for full details. Limited quantity available.

Cat. CT-1952

Was \$99.00 Save \$24.00 January \$75.00



## 15" 200 WATT PROFESSIONAL PA DRIVER

Suitable for high power PA applications. Power handling 200WRMS. Will work OK in both sealed and vented boxes. See 96 catalogue, page 49 for full details. Cat. CG-2388

Was \$239 Now \$199 Save \$40



## VIFA D19 TWEETER

Save a massive \$10 in January. See 96 catalogue, page 38 for full details. Cat. CT-2019

Was \$39.50 Jan Only \$29.50 Save \$10



BUY 10 LESS 10%

## SEMI CONDUCTOR PACK



BRAND NEW PACK full of brand new semiconductors, diodes etc. Min. quantity in bags 100 pcs. Cat. ZP-8990

Only \$10

## JAYCAR PULSE COUNT PIR

See 96 catalogue, page 151 for full details.

Cat. LA-5025

Cat. Price

\$29.95 Jan. Price \$25ea. or 5 for \$110.00



## MICROWAVE OVEN LEAK DETECTOR

Keep an eye on your microwave oven for harmful leaks.

Cat. QM-7260

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## CEILING MOUNT PIR

This PIR will mount on the ceiling and features pulse count operation which helps eliminate false alarms.

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Cat. Price \$49.95

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## NICAD BUTTON CELL

Make your own Nicad packs. Used in many cordless telephone battery packs. Capacity - 280mAh. Voltage 1.2V. Size 25(Dia.) x 8.8(H)mm. See 96 catalogue, page 72 for full details.

Cat. SB-2470

Was \$2.95 Now \$1.95 Save \$1



## DIGITAL TYRE PRESSURE GAUGE

Reads digitally in PSI Cat.

QM-7235 Was \$19.95 Jan \$15.00 Save \$4.95

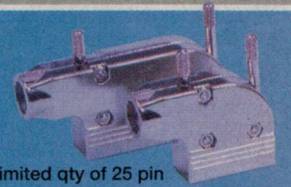


## BACKSHELL BARGAINS

These are right angle and metal.

DESCRIPTION	CAT. NO.	WAS	NOW	10 PLUS
9 pin	PM-0814	\$3.95	\$2.50	\$2.00
15 pin	PM-0834	\$4.25	\$2.70	\$2.20
25 pin	PM-0849	\$4.50	\$3.00	\$2.60

Very limited qty of 25 pin



## ALL JAYCAR STORES ARE NOW ON EFTPOS!!!

## SOLAR CAR BATTERY BOOSTER

Keep a small charge feeding your battery while you are away, or not using the car. See 96 catalogue, page 74. Limited quantity available.

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Was \$29.95

Jan \$22.95

Save \$7 This Month

## ADD ULTRASONIC TO YOUR CAR ALARM FOR EXTRA SAFETY

Will connect to any car alarm that has a spare input wire. Will pick up a thief who breaks a window and crawls in, therefore by passing the voltage drop caused by the door opening/interior light. See 96 catalogue, page 158. Cat. LA-8906

Was \$64.95 Save \$20 January \$44.95



## 12V CELLULAR PHONE / VIDEO BATTERY DISCHARGER, DEEP CONDITIONER & FAST CHARGER

Suitable for Ni-cad & Ni-mh cells.

Features:- •When battery is charged, switches to trickle charge •Discharges then automatically fast charges •Deep conditioning of Ni-cads with memory effect. Battery is automatically discharged and charged 3 times •Self test mode •Temperature sensor •Powered by 12V. For 240V use 1A mains adaptor. Cat. MP-3015 \$22.95.

Adaptors required for different batteries.

Charger supplied with Motorola Microtac adaptor.

Other adaptors: All \$12.95 each •Motorola 8000/9000/9800 7.2V - Cat. MB3555 •NEC P3/P300 6.0V - Cat. MB3556 •Ericsson 237/337 6.0V - Cat. MB3557 •Oki 700 6.0V - Cat. MB3558 •Oki 900 6.0V - Cat. MB3558 •Nokia 2110 6.0V - Cat. MB3559 •Nokia 100/101/121 - Cat. MB3560 Video Camera Battery Adaptors: •Sharp, Hitachi, Sony - Cat. MB3565 •Panasonic, Canon, JVC - Cat. MB3566

## CELLULAR PHONE CHARGER

Cat. MB-3550 Was \$69.95

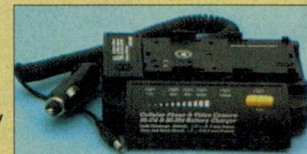
240V Adaptor \$22.95

Total \$92.90

Save \$22.95

\*\*Charger is supplied with cigarette lighter lead, 240V adaptor and Microtac adaptor

Now Only \$69.95



## UNBELIEVABLE SURPLUS SPEAKER DEALS

We have made a massive purchase of some discontinued speakers from Etone. The speakers are NOVIK brand and are made in Brazil. NOVIK have been around for some time, we even used to sell them some years ago. Ideal replacement speakers. Save up to 50%. Limited quantities.

### 12" WOOFER

Power handling 40WRMS  
Frequency response 30Hz - 3.5kHz. Paper cone, plastic front surround. Speaker weight 1.6Kg.

Cat. CW-2124



**Only \$29.95ea**

### 10" WOOFER

Power handling 40WRMS  
Frequency response 35Hz - 4.0kHz. Paper cone, plastic front surround. Speaker weight 1286gr.

Cat. CW-2120



**Only \$24.95ea**

### 5" MIDRANGE

Power handling 120WRMS  
system power. Suggested crossover points - 800Hz and 5Khz. Clear polypropylene cone. Speaker weight 590gr.

Cat. CM-2070



**\$14.95**

### DOME MIDRANGE

Power handling 150WRMS  
system power. Suggested crossover points 500Hz & top crossover point between 5Khz and 12Khz. Speaker weight 810g. Size 130W x 114Hmm front. Cutout about 90mm dia. 1.5" (38mm) dome. Cat. CM-2074



**\$24.95**

### 6" 8Ω TWINCONE

Ideal low cost replacement speaker. Has a twincone and cardboard cone. power handling is around 6watts. Diagonal mounting holes 155mm. Weight 353gr.

Cat. AS-3013



**\$7.95**

### 8" TWINCONE PA SPEAKER

This twincone 8" speaker is ideal for PA. It is very similar to our CE-2325 model, except that it does not have mounting holes for a line transformer. Power handling is 10WRMS. Frequency response is about 100Hz to 17,000HZ. Weight 430gr.

Cat. CE-2326



**\$12.95**

### ROUND CONE TWEETER

Power handling - about 50WRMS system. Frequency range 2K - 16Khz. Suggested crossover point is about 3Khz. Overall diameter 85mm. Cutout size - min.55mm. Weight 108gr.

Cat. CT-2001



**\$9.95**

### SQUARE CONE TWEETER

Power handling - about 50WRMS system. Frequency range 2K - 16Khz. Suggested x'over point is about 3Khz. Size - 57 x 57mm. Cutout size 55mm. Weight 93gr.

Cat. CT-2002



**\$7.95**

### PIEZO TWEETER

Power handling 120WRMS, no crossover required. Front panel size 135(W) x 65(H)mm.

Cat. CT-1915 **\$8.95**



## Communications Speaker With Noise Filter

Impedance is 8 ohms, power handling is 8 watts, maximum 15 watts and incorporates a noise filter with on/off switch. Supplied with 2 metres of cable to a 3.5mm mono plug. Size - 100(W) x 100(H) x 62(D)mm.

Limited quantity. Cat. AS-3190

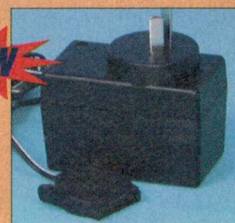
**Was \$24.95 Save \$10  
Now \$14.95**



## 6V NICAD CHARGER

ARLEC brand 6.6V 110mA Nicad charger. These were designed to charge a cellular telephone battery. The lead terminates to a strange plug which needs to be removed. Ideal for charging any 6V Nicad or 5 x 1.2V in series in a battery holder, or Nicad packs etc., etc.

**Limited quantity available Cat. MB-3506  
Only \$7.50 or 10 for \$50**



## SUPER DRILL SET

Fantastic new drill with precision quick-change chuck. Perfect for drilling, polishing, engraving, routing, shaping, sanding and milling. Supplied with the following accessories: •5 collets - Dia. 0.5, 1.0, 1.5, 2.4 and 3.0mm. •4 different shaped grindstones with abour. •1 super thin grinding wheel. •5 sized drill bits. •240V mains plug pack.



Cat. TD-2460

**\$59.95**

## SAVE \$20 ON CAR AMP 24WRMS X 4 CHANNELS

Features - Hi-Low level input, auto on/off with head unit, adjustable gain control. See 1996 catalogue, page 67.

**Was \$119.50 Save \$20**

Cat. AA-0410



**Jan \$99.50**

## BREADBOARD REDUCED !!!

We've negotiated better pricing and passing the savings on! See 1996 catalogue page 92 for full details.

**NEW**

DESCRIPTION	CAT.	Was	Now	Save
Distribution Strip - 100 hole	PB-8810	\$4.25	\$3.75	\$0.50
Terminal Strip - 630 hole	PB-8812	\$13.50	\$9.95	\$3.55
830 Point Breadboard	PB-8814	\$18.95	\$14.95	\$4.00
1660 Point Breadboard/Plate	PB-8816	\$44.95	\$29.95	\$15.00
2390 Point Breadboard/Plate	PB-8818	\$56.95	\$42.95	\$14.00
3220 Point Breadboard/Plate	PB-8820	\$75.00	\$54.95	\$20.05

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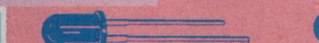
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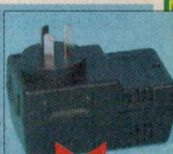
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**Local designer explains how it was achieved:**

# PERFORMANCE JUMP IN NEW VAF KIT SPEAKERS

VAF Research, one of Australia's most innovative loudspeaker manufacturers, seems to have set a new standard of performance with the release of its new DC-X model. It offers high sensitivity coupled with a particularly linear frequency and phase response and exceptional transient performance — from a system in which the electrical crossover network has been effectively eliminated! In this article the firm's MD and chief designer explains how the new design emerged from VAF's intensive research into physical acoustic engineering.

by **PHILIP VAFIADIS**

Let's get straight to the point. The main performance features VAF is claiming for the new DC-X system are:

- Very high sensitivity — over 95dB/W at 1m;
- Very linear frequency response — from 35Hz to 19kHz  $\pm$ 2dB (-3dB at 31Hz), measured on the tweeter axis at three metres, using MLS sequence and 1/3 octave smoothing;
- Very linear phase response — almost flat from 100Hz - 20kHz;
- Very low distortion — under 1% at most frequencies, at 100dB; and
- Very fast cumulative spectral decay: -15dB in 0.2ms for most frequencies.

While these features are very impressive, the astonishing thing is that, unlike other high quality loudspeakers, the VAF DC-X achieves this level of accuracy with an electrical crossover that consists of just one capacitor and nothing else!

The intention of this article is to give readers some insight into how the VAF DC-X does what it does. I'll also show how you can do it for yourself too!

## The background

Regular readers of *EA* will be aware that, from the release of their first kit loudspeakers in November 1992, VAF rapidly became one of the most popular suppliers of high quality kit speakers in Australia. We attribute this success to VAF's genuine desire to push the state of the art, and also to our being prepared to be 'a little different' in order to offer the most accurate sound reproduction we can, at any time.

For quite some time now we have been frustrated by the limitations in conventional loudspeaker design techniques. In particular, the accepted practice in loudspeaker design was to tolerate some per-



formance anomalies produced by driver/enclosure combinations, and then try to 'fix' them with a complicated electrical crossover — after they have happened. While VAF's designers have achieved very good results with such designs, we knew that it was far from ideal to allow a problem to occur and then to correct it after it has occurred. It would be much better if driver/enclosure combinations could be engineered to do the right thing in the first place.

To this end VAF embarked on what it believes is the most significant R&D program undertaken by an Australian loudspeaker manufacturer in many years. This R&D program has already yielded a number of successful loudspeakers (see 'Technology leap in new VAF speakers', in *EA* for January 1996). The new VAF DC-X, however, takes this a step further.

## Emphasis on accuracy

It seems that every time we pick up a new magazine about audio equipment there are claims of unrivalled sound quality, new features that you just can't do without — or amazing new technology to replace the amazing new technology in last year's model! Cynically most of us begin to ask "Where's the proof?". With the introduction of the new DC-X, VAF happily invites closer technical scrutiny, with an emphasis on sound reproduction accuracy. (It is worth noting that VAF invites well considered scientific and technical criticism of their loudspeakers, and we actually use this feedback in our designs.)

You can see from the accompanying impulse, cumulative spectral decay, distortion, amplitude vs frequency and phase vs frequency plots that the new DC-X loudspeakers are very accurate indeed.

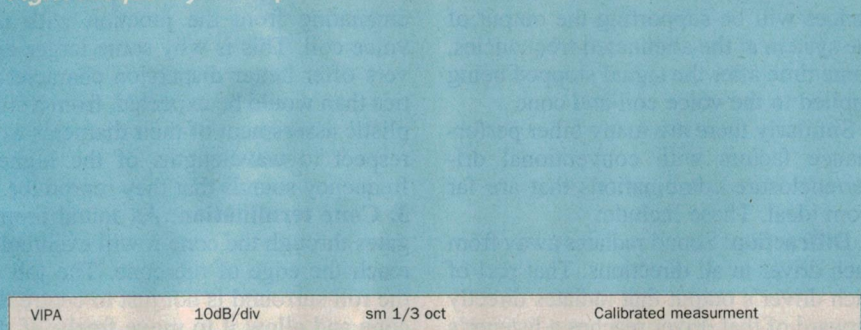
It was this quest for accuracy at VAF that was a significant motivation for our new physical engineering technology, the technology to which the new DC-X loudspeakers owe their existence.

In a conventional loudspeaker the electrical crossover's most basic function is to limit the bandwidth of the signal reaching each driver — i.e., bass is fed to the bass driver and treble to the tweeter etc. Designers of high quality systems use a number of other electrical techniques in an attempt to correct various response anomalies in driver/enclosure combinations. For instance almost all bass/mid drivers used in two-way loudspeakers have cone break-up modes that result in resonances that increase the output of the driver at certain frequencies.

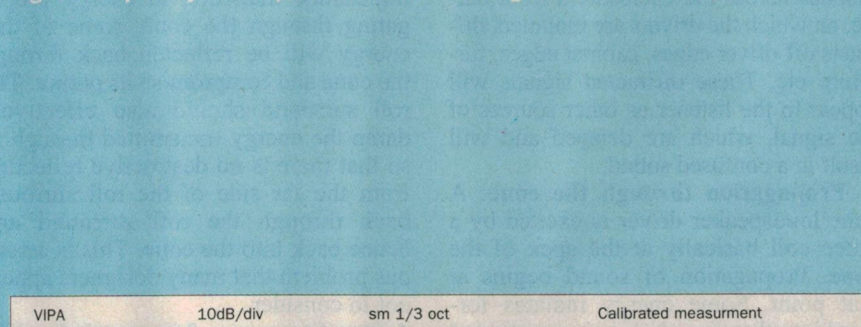
The use of tuned resonant circuits or step filters to attenuate this extra output is

## Frequency response, Phase, Impedance

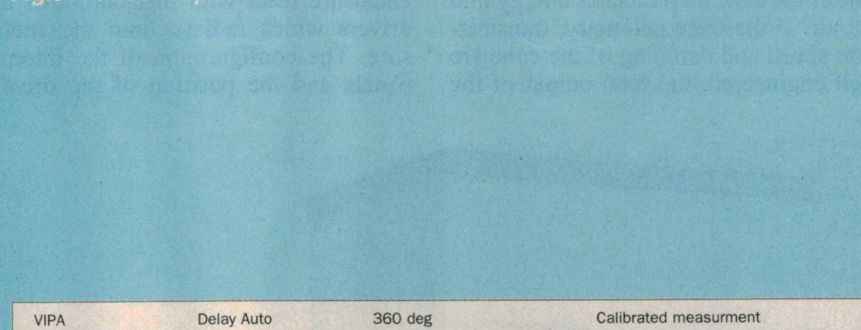
*Fig.1: Frequency vs amplitude at 3m on the tweeter axis*



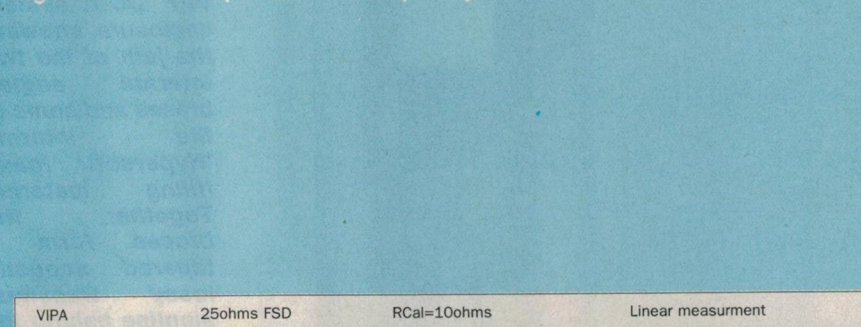
*Fig.2: Frequency vs amplitude at 3m - 30 degrees off horizontal axis*



*Fig.3: Phase response measured at 3m on the tweeter axis*



*Fig.6: Electrical Impedance vs frequency*



common in high quality loudspeakers. While this can achieve good results in comparison to loudspeakers that are not so thoughtfully designed, it is self-evident that the extra output of the cone due to its resonant behaviour results in stored

energy, which will seriously compromise the cumulative spectral decay (i.e., transient response) of the system.

Furthermore, while the corrected amplitude vs frequency response may appear accurate, such a system will not

sound tonally accurate as the cone resonances will be supporting the output of the system at the attenuated frequencies, some time after the signal stopped being applied to the voice coil and cone.

Similarly there are many other performance factors with conventional driver/enclosure combinations that are far from ideal. These include:

**1. Diffraction:** Sound radiates away from each driver in all directions. That part of each driver's output that radiates directly forward of that driver reaches a listener's ears unimpeded by anything. Sound that radiates across the enclosure's front baffle, on which the drivers are mounted, diffracts off driver edges, cabinet edges, furniture etc. These diffracted signals will appear to the listener as other sources of the signal, which are delayed and will result in a confused sound.

**2. Propagation through the cone:** A cone loudspeaker driver is excited by a voice coil basically at the apex of the cone. Propagation of sound begins at that point. Some energy radiates forward into the air and some is propagated radially outward through the cone. Each part of the cone then radiates energy into the air. If the cone geometry, transmission speed and damping of the cone are well engineered, the total output of the

cone will approximate a point source emanating from the junction with the voice coil. This is why some larger drivers offer better dispersion characteristics than would be expected, from a simplistic assessment of their diameter with respect to wavelengths of the highest frequency sounds that they reproduce.

**3. Cone termination:** As sound propagates through the cone it will eventually reach the edge of the cone. The job of the roll surround is not just to centre the cone and allow it to move freely. If the roll surround does not present a smooth impedance transition to energy propagating through the cone, some of that energy will be reflected back through the cone and compromise its output. The roll surround should also effectively damp the energy transmitted through it, so that there is no destructive reflection from the far side of the roll surround back through the roll surround and hence back into the cone. This is a serious problem that many designers appear not to consider.

**4. Standing waves & transmission line effects:** The internal surfaces of an enclosure react with that output of the drivers which radiates into the enclosure. The configuration of the internal panels and the position of the drivers

with regard to those panels have a significant impact on the load experienced by the driver, and hence its response. Also any rear radiation from the driver that reflects off the inside the enclosure and returns to the driver will be transmitted through the driver's cone, to some extent.

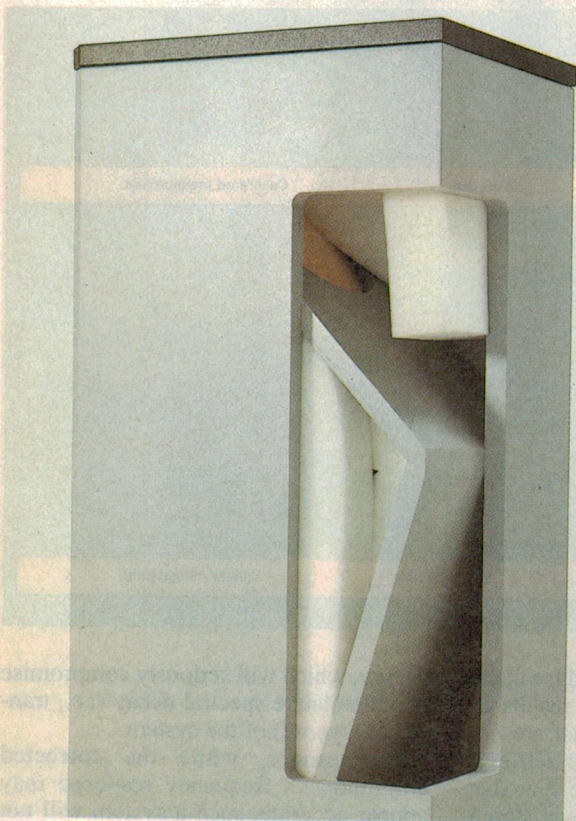
**5. Cabinet resonances:** No cabinet can be made infinitely rigid nor perfectly damped. All parts of a loudspeaker cabinet will be excited into resonance when a driver fitted into it is operating. Like resonances in the cone of a driver, resonances in the enclosure will result in stored energy that will compromise the cumulative spectral decay of the system. Also cabinet rigidity in most commercial designs has a measurable effect on low frequency system Q, which will be non-linear with regard to the driver output.

**6. Electrical damping:** In a conventional loudspeaker a good deal of the low frequency damping available to the system is electrical damping, offered by the amplifier driving the loudspeaker. Any significant resistance between the woofer and the amplifier will compromise this electrical damping.

**7. Differing arrival times of signals from each driver in a system:** In a conventional loudspeaker with a dome tweeter and cone woofer mounted in an enclosure with a flat front, in most normal listening positions the sound from the tweeter will arrive at the listener's ears a short time before the sound from the woofer does. This has a destructive effect on the system's overall phase response and its ability to accurately portray dynamic detail.

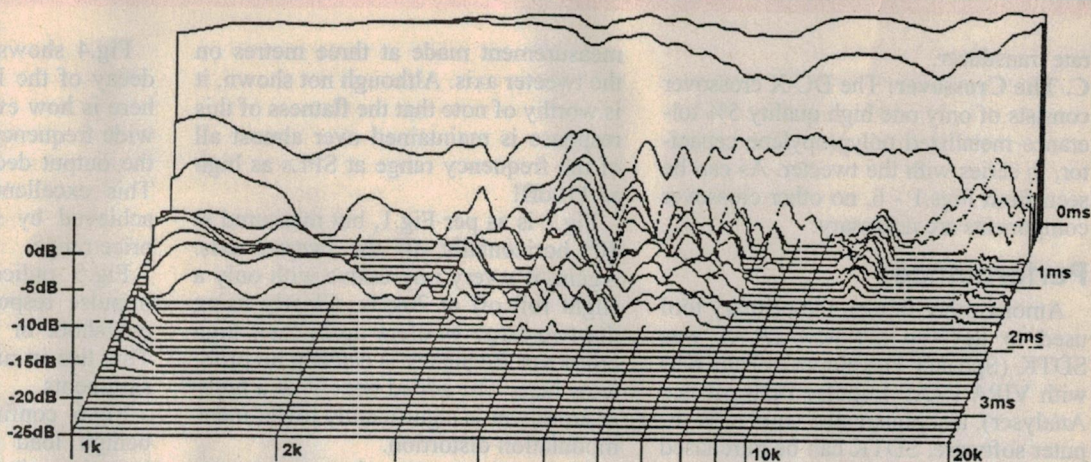
**8. Stored energy and other time/phase problems inherent in electrical crossovers:** All reactive components used in crossover networks (i.e., most of the components in the crossover) store energy. The higher the electrical Q of the filter, the worse the problem is. Again this will be destructive to the cumulative spectral decay of the system. I am sure most designers would be amazed at how bad the cumulative spectral decay of most commercial loudspeakers is, even measured before the signal reaches the drivers! Also a crossover that is not sympathetic to the acoustic phase output of the drivers mounted in their enclosures is a guarantee that the loudspeakers will not image or sound stage well.

While this list is far from complete, it represents the fundamental set of issues that face a designer of modern loudspeakers.

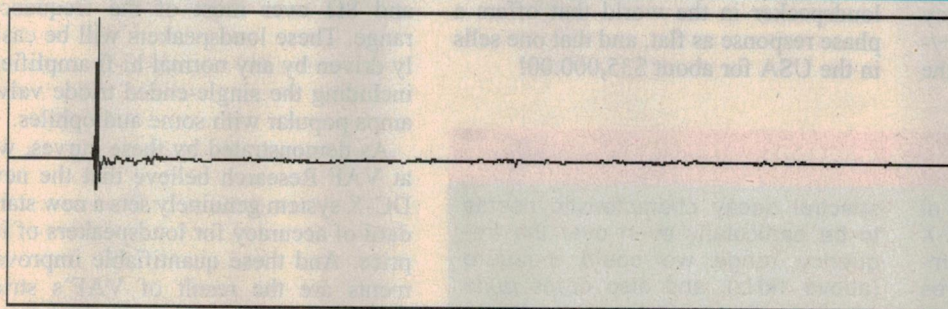


*A photo of a cut-away version of a VAF DC-X system enclosure, showing the join of the two internal angled braces and some of the internal 'Hypersoft foam' filling material. Together the braces form a tapered acoustic lossy transmission line behind the woofers.*

**Fig.4:** The cumulative spectral decay characteristic of a VAF DC-X speaker enclosure, as measured by VAF using its computer-controlled testing system and newly developed software. Note the well-balanced and relatively rapid decay, with very few resonances evident. Our own test gave a very similar result.



## Impulse response



**Fig.5:** The impulse response for a DC-X enclosure, again as measured by VAF's own system. As you can see it's quite clean and shows very little ringing — which augurs well for the system's transient response and 'transparency' when playing music.

## Tackling the problems

From its inception, the DC-X design team knew that physical aspects of the DC-X's would need to be optimised in order to achieve accurate performance without the assistance of the electrical crossover. To this end a time-aligned vertical symmetrical array was chosen as the natural starting point. It has been well understood for some time that well-optimised first order crossovers, used with this type of driver configuration, is currently the 'state of the art' among passive loudspeaker designs.

As with most leading edge design companies, VAF is understandably cautious in revealing all about technologies that offer it a commercial advantage over competitors. Without giving too much away, the new VAF DC-X is basically a product of the following building blocks.

**A. Drivers:** Each enclosure houses two 210mm diameter composite fibreglass cone woofers and one soft dome shallow horn tweeter. The woofers have been specially made to VAF's specifications in Europe, and are not an 'off the shelf' driver available to other manufacturers.

There are similar looking woofers in a number of loudspeakers from other high quality international manufacturers,

however the VAF DC-X drivers are unique. They feature a 'T' shaped pole piece and large, high temperature, edge-wound voice coil assembly on an aluminium former. This motor structure offers exceptional dynamic linearity and provides a linear excursion of 9.5mm and a total excursion of over 20mm.

The cone geometry has been very closely matched to the material it is made from. The composite fibreglass cone has been moulded using resins that provide exceptional damping. Each cone is then fitted at VAF with a number of felt pads which further enhance optimum propagation of sound through the cone.

The cone is terminated in a very compliant soft rubber surround. It is a credit to its designers that this woofer in the DC-X enclosure has a smooth response to over 8kHz, while still having a free air resonance of a very low 28Hz. When mounted in the DC-X enclosure the woofer requires no extra tailoring and offers almost 'textbook perfect' performance. Considering the relatively high crossover frequency of 6 - 8kHz, you can see from the off axis amplitude vs frequency response that there is no problem with off-axis output.

The tweeters are also a special unit manufactured for VAF. Finding a tweet-

er sensitive enough for the DC-X but still being of very high quality proved to be quite a challenge. All the tweeters that were originally tested were either not sensitive enough or not accurate enough. At the last moment, when it looked like VAF would have to compromise on sensitivity, a European manufacturer came to the rescue.

As with the woofer, VAF provided input regarding the tweeter's final configuration. This driver has a 25mm treated textile dome driven by a high quality liquid cooled voicecoil assembly, and a large magnet structure. A shallow horn is fitted in front of the dome and this has been very carefully shaped to provide a very flat overall response, high sensitivity and a dispersion characteristic that almost perfectly matches that of the woofer.

**B. Cabinet:** The large DC-X cabinets are a little unusual (see Fig.7). They feature two angled braces, the lower of which forms a tapered line behind the woofers. Strategically positioned Hypersoft foam effectively attenuates rear radiation from the woofers as it progresses down the tapered line. Very little of the rear radiation reflects back to the rear of the woofers, and hence cannot be destructive to the woofers' output. This is critical to the DC-X system's operation as an accu-

## VAF DC-X Speaker Kit

rate transducer.

**C. The Crossover:** The DC-X crossover consists of only one high quality 5% tolerance metallized polypropylene capacitor, in series with the tweeter. As can be seen from Figs.1 - 6, no other crossover components are necessary.

### Performance

Among other things, the primary tool used to develop the new DC-X was SSDK (Speaker Developer's Tool Kit) with VIPA (VAF Impulse Performance Analyser), a sophisticated suite of computer software. SSDK can be purchased directly from VAF. The VIPA module will be available shortly.

Fig.1 shows a remarkably flat and smooth amplitude vs frequency response. This sample measures  $\pm 1.5$ dB from 35Hz to 20kHz, with the

measurement made at three metres on the tweeter axis. Although not shown, it is worthy of note that the flatness of this response is maintained over almost all of the frequency range at SPLs as high as 110dB!

Fig.2 is as per Fig.1, but measured at 30° horizontally off the tweeter axis. Again, it's very impressive with only a slight roll off at 20kHz. Clearly using the two large woofers up to their high crossover frequency is causing no problems here. The added benefit of a higher crossover is significantly lower inter-modulation distortion.

Fig.3 shows the phase response. Frankly this is a remarkable result. VAF is aware of only one other non-active loudspeaker in the world that offers a phase response as flat, and that one sells in the USA for about \$35,000.00!

Fig.4 shows the cumulative spectral decay of the DC-X. The thing to note here is how evenly the decay is, over a wide frequency range, and how quickly the output decays into the noise floor. This excellent result is almost never achieved by speakers in the DC-X's price range.

Fig.5 indicates a fast and narrow impulse response, with little negative overshoot or 'fuzz' after the impulse. This ties in nicely with the other measurements.

Fig.6 confirms the DC-X system's benign load to amplifiers. Minimum impedance is  $4\Omega$ , with the maximum at bass resonance of a low  $12.5\Omega$ . The impedance easily remains between  $4\Omega$  and  $8\Omega$  over most of the frequency range. These loudspeakers will be easily driven by any normal hi-fi amplifier, including the single-ended triode valve amps popular with some audiophiles.

As demonstrated by these curves, we at VAF Research believe that the new DC-X system genuinely sets a new standard of accuracy for loudspeakers of its price. And these quantifiable improvements are the result of VAF's strict adherence to a scientific methodology, in the DC-X system's development.

### Construction

For those wishing to build their own cabinets, follow Fig.7. (Plans are provided with kits bought from VAF).

As can be seen from this diagram, the cabinet is made from Medium Density Fibreboard (MDF). Home constructors should note that all MDF is not the same, and the differences will effect the sound of the system. The best MDF to use in Australia is the one sold by Laminex Industries which is Australian made and is available in all Australian states.

A good quality MDF adhesive should be used, such as Laminex's AV180. Normal PVA glues that are used with particle board require moisture in the glue to be absorbed by the board to cure. MDF does not absorb as much moisture as particle board, and bond strength will be compromised if a normal PVA glue is used. Of course two-part glues such as epoxy can be used too.

Home constructors should also NOT make changes to the dimensions of the DC-X. There is an incorrect belief among many audio enthusiasts that as long as the internal volume of the enclosure is the same, the enclosure dimensions may be altered. Reflections and diffraction both inside

### How EA found the VAF DC-X system...

Philip Vafiadis is justifiably proud of his company's new DC-X Loudspeaker Kit, and sent over a sample pair of built up DC-X enclosures with the express wish that we should both test them with our instruments and also listen to them critically.

Needless to say we were happy to do so, for two reasons. One was our experience with VAF's previous designs, which have been very impressive in terms of their performance/price ratio. But quite apart from this, we've also been aware of the painstaking research that Mr Vafiadis and his team have been undertaking recently, and that at least some of the fruits of this work have been incorporated into the new DC-X system.

Tested with both our IMP computer-based measurement system (in some cases backed up by our LMS system as well), the DC-X speakers gave plots which agreed closely with those supplied by VAF. Although we could only take our own measurements at 2m, due to the limitations of our testing room, the measured on-axis frequency response was very smooth indeed, and comfortably within the rated  $\pm 2$ dB up to about 16kHz. We did find a small peak of about +3dB just below 20kHz, but this is unlikely to be of any consequence. The response at 30° off axis was similarly very smooth, falling off quite slowly at the top end, and the phase response also commendably smooth.

As VAF claims, the cumulative

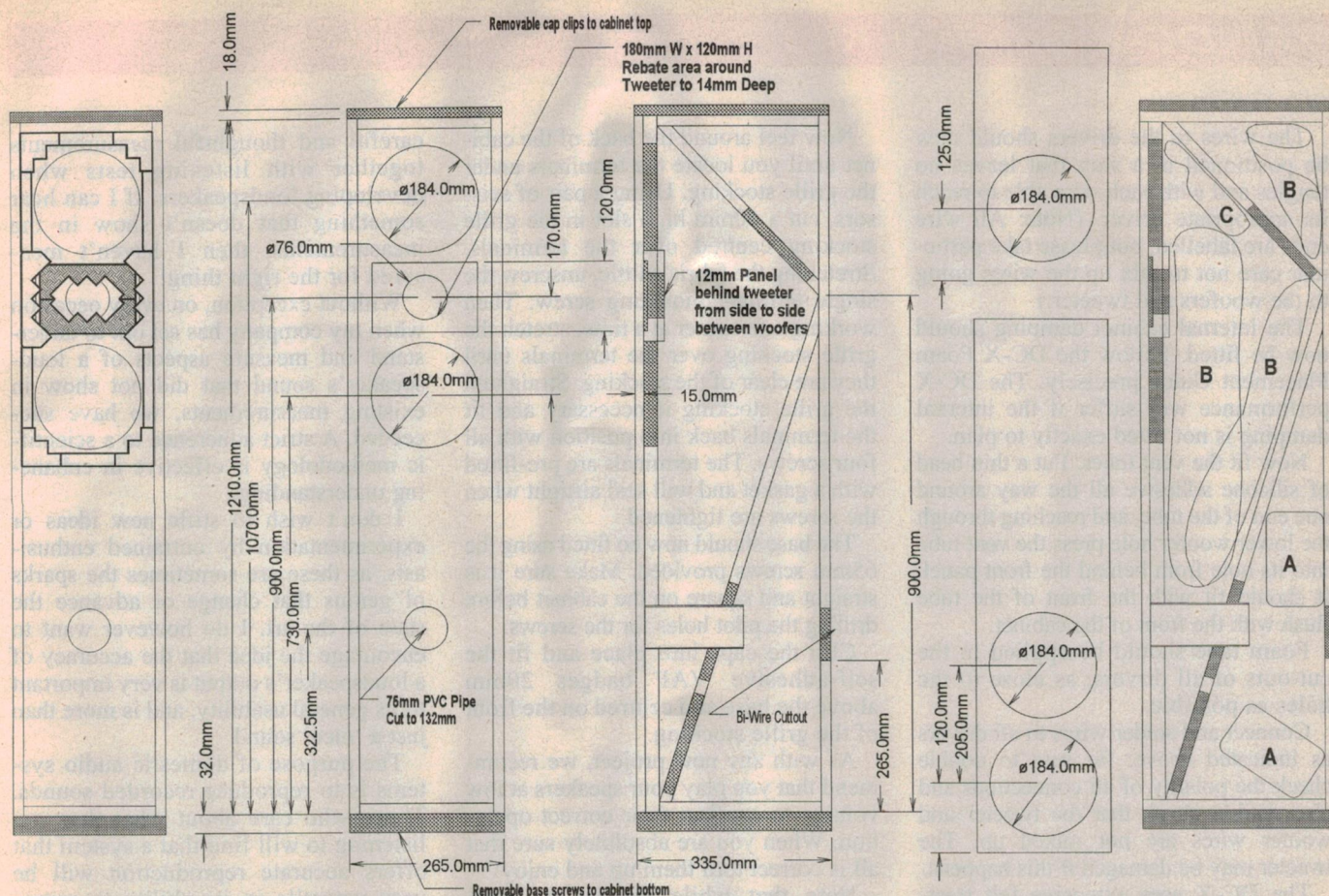
spectral decay characteristic seems to be particularly even over the frequency range we could measure (above 1kHz), and also drops quite rapidly — in fact the sample fell to below -20dB after only 1ms, and to below -40dB before 2ms. All of which augurs very well for the system's transient response, of course.

We also checked the electrical impedance of the system, and verified that it is very well controlled over the full audio range as shown in VAF's curve (Fig.6).

As well as making these measurements we subjected the sample DC-X system to critical listening tests, in a typical domestic lounge room environment. And using the system to listen to a variety of familiar and high quality tracks from CDs, we have been very impressed indeed.

Probably the best way to summarise our reactions to the listening tests of the DC-X system is that apart from being particularly smooth and tonally balanced over the full audio range, it seems to have exceptional transient performance. This results in very 'clean' and transparent reproduction, even with complex string and choral/orchestral music, and also in exceptionally stable and well defined stereo imaging.

In short, we're happy to endorse this new VAF kit speaker system, which delivers a level of performance comparable with much more expensive built-up systems. (J.R.)



**Fig.7: Diagrams showing the construction of the VAF DC-X enclosures, and the way internal braces and acoustic damping materials are used to achieve their impressive performance. At far right, the letters A, B and C identify pieces of selected Hypersoft foam, while the view at far left shows the location of the 28 different pieces of felt around the front of the drivers.**

and outside the enclosure have serious impact on the system's output. VAF has gone to a lot of trouble to properly control these, with complex felt and foam arrangements (see Fig.7), and these or the dimensions of the enclosure should not be altered without checking with VAF first.

Fully assembled and finished cabinets are available from VAF for constructors who would prefer not to bother with that part of the process.

DC-X kits are only available directly from VAF Research and are provided with all parts required to complete their construction (see photo). VAF includes the following parts in the DC-X kits:

**Bass Drivers:** Four VAF DC-215F4 215mm treated composite cone woofers  
**Treble Drivers:** Two VAF DCH 25 dome tweeters

**Crossovers & Terminals:** Two moulded bi-wire housings with tweeter capacitors and labelled wiring looms attached. The moulded housing is fitted with a gasket to ensure an airtight seal.

#### Damping Material:

**Foam:** Four pieces 245mm x 100mm x 165mm Special Hypersoft II foam; eight pieces 500mm x 145mm x 50mm Special Hypersoft II foam; two pieces 235mm x 170mm x 60mm Special Hypersoft III foam

**Felt:** Kit A, containing eight pieces; Kit B, containing four pieces; Kit C, containing eight pieces; Kit D, containing four pieces; and Kit E, containing four pieces.

**Badges:** Two engraved, self adhesive gold coloured VAF badges.

**Screws & Washers:** 8 x countersunk screws for mounting terminal housing; 16 x washers for use with woofer mounting screws; 24 x pan head screws for mounting drivers; 8 x 65mm screws to mount bases.

**Cap Clips:** 8 x male and female moulded clips to fit caps to cabinets.

**Foam Tape:** 1 x 3.9m roll of 6mm x 1.6mm closed cell foam tape for airtight fitting of drivers.

**Cabinets:** Two fully assembled, pre-finished, all MDF cabinets. The cabinet

caps and bases are lacquered to a very high standard. (Note that kits may be purchased without cabinets if required.)

#### Simple procedure

The VAF DC-X kits have been designed with 'foolproof' assembly in mind. Just follow these simple instructions carefully and within a short time you will be enjoying their accurate, balanced and detailed sound:

First fit the crossovers and terminals. A single capacitor of high quality is already mounted to the terminal housing and a wiring loom is also pre-attached. Fit this assembly through the rear of the cabinet.

Through the screw holes in the terminal housing drill four pilot holes for the mounting screws. Make sure the terminal housing is square with the cabinet before you drill. Then find the press-seal bag with eight countersunk screws, and use only one of these screws to secure the terminal housings at this time. The other screws are fitted after the grille stocking is fitted.

The wires to the drivers should now be positioned in a way that leaves no tangles and with each wire able to reach its appropriate driver. (Note: All wire ends are labelled, but please take particular care not to mix up the wires going to the woofers and tweeter.)

The internal cabinet damping should now be fitted. Follow the DC-X Foam Placement Guide precisely. The DC-X performance will suffer if the internal damping is not fitted exactly to plan.

Now fit the vent tubes. Put a thin bead of silicone adhesive all the way around one end of the tube, and reaching through the lower woofer hole press the vent tube into its hole from behind the front panel. It should fit with the front of the tube flush with the front of the cabinet.

Foam tape should be applied to the cut-outs of all drivers, as close to the holes as possible.

Connect and solder wires to all drivers as indicated above. Be sure to double check the polarity of all connections and also double check that the tweeter and woofer wires are not mixed up. The tweeter may be damaged if this happens.

The DC-X uses extensive felt treatment to the cabinet baffle. This is an integral part of the design and must be placed carefully in order to achieve the quoted  $\pm 2$ dB response. Using the DC-X Felt Placement Guide, fit felt kits A, B, C, D and E. A total of 14 separate pieces fit to each cabinet.

Now fit the male parts of the two-part cap clips to the caps. Use the female part as a protector and tap each male part into the cap lightly with a hammer. The female part of the clips should now be fitted into the holes in the cabinet tops.

The pre-stitched grille stockings should now be stretched neatly and evenly over the cabinets. Make sure that the seam is straight and centred on the back. Don't worry about the terminals just yet — let the cloth cover them for now.

Find the rubber spline and while stretching the grille stocking just a little, press the stocking into the groove at the top of the cabinet with the spline. Use the end of a ruler or a coin as a tool if necessary. Turn the cabinet onto its top and repeat the process with the groove on the bottom of the cabinet. When you are sure that the grille stocking is fitted correctly, trim off all excess fabric to the inside edge of both grooves so that the cap and base fit snugly against the cabinet.

Now feel around the back of the cabinet until you locate the terminals under the grille stocking. Using a pair of scissors, cut a 60mm high slot in the grille stocking centred over the terminals. Stretching the fabric a little, unscrew the single terminal mounting screw. Then working one corner at a time, stretch the grille stocking over the terminals until they are clear of the stocking. Straighten the grille stocking if necessary and fit the terminals back into position with all four screws. The terminals are pre-fitted with a gasket and will seal airtight when the screws are tightened.

The base should now be fitted using the 65mm screws provided. Make sure it is straight and square on the cabinet before drilling the pilot holes for the screws.

Clip the caps into place and fit the self-adhesive VAF badges 20mm above the base and centred on the front of the grille stocking.

As with any new project, we recommend that you play your speakers at low volume to confirm their correct operation. When you are absolutely sure that all is correct turn them up and enjoy!

Note that while the DC-X loudspeakers will perform satisfactorily from their first audition, they require approximately 40 to 50 hours of running-in to perform properly. All loudspeaker drivers are mechanical devices with suspension parts that must soften a little for best performance. Any music source at any reasonable level can be used to run in the loudspeakers. The drivers used in the DC-X are very high quality units and once run in will offer many years of ideal performance.

For constructors who intend using the DC-X loudspeakers in a home theatre system, VAF now offers a range of centre channel and rear channel speakers with similar features as those of the DC-X. These are available as separate items or can be purchased with the DC-X loudspeakers at a discounted package price. Contact VAF for further details.

### Concluding notes

In this article I have stressed the accuracy of the new DC-X loudspeakers, and supported this with tangible performance measurements. While measurements do not fully express the sound of a loudspeaker, it is self evident that no loudspeaker can sound more accurate than it measures.

At VAF we use a combination of

careful and thoughtful measurements together with listening tests when developing loudspeakers. If I can hear something that doesn't show in the measurements, then I haven't measured for the right thing!

Without exception, on every occasion when my company has set out to understand and measure aspects of a loudspeaker's sound that did not show in existing measurements, we have succeeded. A strict adherence to a scientific methodology is effective in enhancing understanding.

I don't wish to stifle new ideas or experimentation by untrained enthusiasts, as these are sometimes the sparks of genius that change or advance the state of the art. I do however want to encourage the idea that the accuracy of a loudspeaker's output is very important to its general usability, and is more than just a 'nice' sound.

The purpose of domestic audio systems is to reproduce recorded sounds. Those who care about what they are listening to will find that a system that offers accurate reproduction will be very versatile in its ability to reproduce many various styles and types of sounds realistically.

While the DC-X's may not be perfect I believe that they, and the processes that created them, genuinely represent an improvement in the state of the art. While our VAF Signature I-66 loudspeakers are more accurate than the DC-X's, they are a 'cost is no object' product. The fact that the DC-X system achieves what it does at the price point is, in my experience, unprecedented.

### Kit price, availability

DC-X kits are available only directly from VAF Research and are priced as follows. Full kits without cabinets are \$1099 per pair, while kits including fully assembled and finished cabinets are \$1399 per pair. Fully assembled and tested DC-X systems are also available, for \$1799 per pair. In each case fully insured freight to anywhere in Australia is an additional \$55 per pair.

An optional eight-piece adjustable spike set is priced at \$24. A three-year guarantee is standard on all VAF speakers even when bought as kits. For further information contact VAF Research at 291 Churchill Road, Prospect SA 5082. Phone 1800 818882 (freecall) or fax (08) 8269 4460. ♦

## The mighty micro

(Continued from page 31)

### The future: change

Change is constant, in a world controlled by microprocessors. And while Intel may be in firm control of the future of microprocessors today, it too faces uncertainties as the next cycle of microprocessor-based intelligence emerges.

The next revolution will probably centre around the Internet and US\$500 Internet computers, powered by Java processors, media processors and other chips that are only now coming out of the R&D labs. Somewhere in Silicon Valley, perhaps in someone's garage, ambitious young engineers will put these chips to work and lay the foundations for the technological innovations of the next millennium.

Even Faggin is still hard at work today on taking the microprocessor to its next level of sophistication, which he believes involves adding neural network-based intelligence to the chips. Faggin's Synaptics company in Silicon Valley is a leading developer of neural networking ICs that will give computing devices human thinking capabilities — as well as sight, hearing, touch, smell and other senses.

Faggin said that future computers will not just operate in our world, they will be able to make sense of the world in which they live.

"Right now the computer is just an extension of us; we don't let them loose on the world," Faggin said. "Once the computer has its own senses, it will be able to function in the world autonomously. They will do the work for us, and do the menial tasks that are a pain for us to do." ♦

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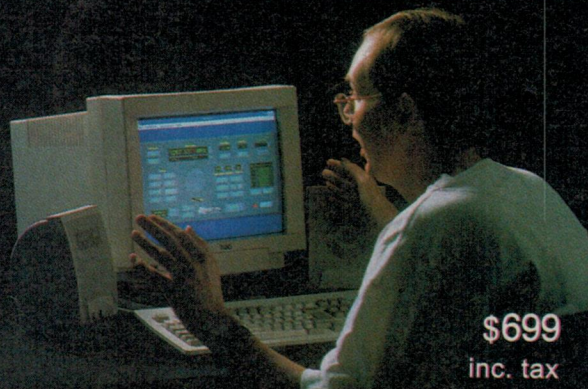
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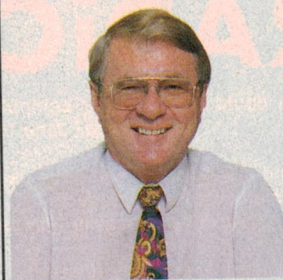
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Regards, Jack O'Donnell, Managing Director

*Jack O'Donnell*

### Pink Noise Generator Kit

**NEW!**

(See Jan '97) Pink noise is used to calibrate audio systems to a particular sound level before they undergo frequency response checks eg. real time analysis, or just simply as a sound level calibration tone. Pink noise sounds like a roaring water fall, and contains a wide spectrum of audio frequencies. This kit has a 60mV output with a -60dB pad switch, and is connected to the audio system's power amplifier. Requires 9V battery (not included).

K 2592 **\$24.95**

### Sound Level Meter Adaptor Kit

(See SC Dec '96) This kit is a useful instrument for measuring sound intensities from 20dB to 120dB, and is plugged into a standard digital multimeter. It features A, C, and unweighted (flat) response filters, with slow, fast and peak reaction times. An ideal piece of test equipment for the audio engineer or installer. Flat response from 28Hz to 50kHz (-3db). Powered by two 9V batteries (not included). The ideal companion to the K 2592 Pink Noise Generator, which can be used to accurately calibrate the sound system under test.

K 2590 **\$55**

**Turn your DMM into an SPL Meter!**

### Hall Effect Current Probe Kit

(See EA Nov '96) Measuring high-potential currents can be fraught with danger, but this kit makes it safer, and has a better accuracy than most clamp-on meters or multimeters. Connected in series with the device under test eg. switchmode power supply, television etc., it allows the current to be observed on a CRO, and uses a Hall effect sensor to effectively isolate the oscilloscope from the line. Features: • Bandwidth DC to 25kHz • Current up to 10A • Negligible inductance & insertion loss • High slew rate (>30A/μs) • 400mV/Amp with ±1% accuracy. • Requires BNC-BNC patch lead to connect to CRO (P 0746)

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### The SCREECHER Car Alarm Kit

**A budget priced theft deterrent for your car!**

A very simple, yet extraordinarily effective deterrent to car theiving persons. Controlled by a hidden switch inside your car, this alarm will sound an ear-piercing 110dB piezo siren inside your vehicle when tripped, making life very uncomfortable for anyone there! Features exit and entry delay, with a soft three second pre-warn in case you forget to deactivate it, a super bright LED warning lamp and two trigger inputs. A budget alternative to commercial car alarms!

K 4360 Normally \$29.95, NOW **\$24.95**

### Stereo Simulator Kit

(See SC June '96) This stereo simulator will add new life to your mono TV or VCR by creating an 'artificial' stereo line output for use with a stereo amplifier. It uses the latest digital delay technology for low noise and distortion. A low cost upgrade for your A/V equipment which adds extra presence to your existing mono system! Supplied with instrument case and silk screened panels.

K 5950 Normally \$79, This Month **\$65**

M 9120 12V AC Plugpack to Suit \$14.50

### Stereo Preamp Kit with Remote Volume

**NEW!**

**Features infra-red, motorised remote volume control!**

(See EA Dec/Jan) This impressive 6 input stereo preamplifier is an attractively priced addition to any hi-fi rack. Features: • Infra-red remote control volume • Power on mute • Bass, treble and mode controls • Dual input switching • Metal chassis CNC turret press punched and screened front and rear panels • Rack mountable with rack "ears" • Easy to construct with minimal wiring • Excellent S/N ratio and distortion figures. An optional RIAA phono preamp module is available if phono (turntable) inputs are required (K 5512).

K 5018 Stereo Preamp Kit **\$269**

K 5512 Phono Preamp Kit \$15.95

### 90 Second Message Recorder Kit

This module is fully self contained, complete with pause/start key, on board microphone for direct recording, in built audio amplifier and playback button. The sound quality is great for static displays, alarms systems, monitoring systems. PA systems etc. Powered from an external 6V DC supply. Even if power is removed the message won't be lost.

K 9570 Was \$95, Now **\$75**

### Automatic NiCad Charger Kit

(EA July '89) Get 100's more recharge cycles from your nicads by charging them correctly. Here is a fully automatic NiCad battery charger that enables differing charge rates for AAA, AA, C, D or 9V cells. Once battery is charged, the unit switches to trickle charge until you switch it off. Requires 12V AC plug pack. Features: • Fully punched and screened case • Variable charge rate & timer • Visual display of charge mode

K 1650 Was \$39.50, NOW **\$35**

### 40V 3A Power Supply Kit



**Includes LCD Digital Display for Precise Measurement!**

(See SC Jan/Feb '94) This 1.23 V to 40 V adjustable power supply is designed for heavy-duty work. With a hefty 3 ampere capacity, it uses a high efficiency switching regulator circuit. Features preset voltage and current limiting, full overload protection (with indicators) and an LCD panel meter for precise voltage and current readouts.

K 3330 Normally \$239, NOW **\$179**

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**EXCLUSIVE TO ALTRONICS!** Attention musos, roadies, installers, and enthusiasts! Here is a great piece of test gear, a Universal Cable Checker. Make sure that your cables are in good shape before a gig or installation. Checks continuity of: • 3-pin XLRs • Mono & stereo 6.35mm jacks • Stereo RCA leads. Features push-to-test button. A tricolour LED display shows the status of each conductor of the lead, so if a short or open circuit exists, you know just where it is! Also has low battery and out-of-phase indicator for checking balanced leads. Supplied with silk screened and punched front panel, available in kit or fully assembled form. Requires 9V battery (not included).

K 2569 Kit Version **\$69**

Q 2590 Built and Tested Version **\$139**

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### 10A Automatic Battery Charger Kit

(See SC June '96) This versatile battery charger can charge 6, 12, or 24V batteries at 10A continuous charge current. Features a sensing circuit to automatically determine what voltage battery is connected and a charge mode. Charging current is automatically switched from high to medium to trickle as the battery reaches full charge. It also has in-built short circuit and reverse polarity protection. Supplied with heavy duty battery leads with alligator clips, screened and punched front panel and case.

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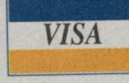
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New PLL 'building block' modules let you

# GENERATE SIGNALS AT HF, VHF OR UHF - 1

Here's the first of three articles describing a pair of compact and flexible phase-locked loop RF modules, which can be used to form the heart of a variety of RF signal sources for the HF, VHF or UHF spectrum. They can be used either 'as is', or in conjunction with an external DDS frequency reference to provide very fine frequency resolution.

by TIBOR BECE

How often have you needed a flexible, easy to use, and compact signal source covering the HF, VHF or UHF frequency bands? There have been a few general purpose signal sources described in the literature, but not too many — so in these articles I'm presenting another variation to the theme.

The new PLL modules to be

described are small, affordable and flexible. They're also ready to be used either 'as-is', with an inbuilt crystal reference oscillator, or in conjunction with my YADDS-1 DDS module (described by Jim Rowe in the September 1995 issue) as an external programmable frequency reference, to provide very fine frequency resolution.

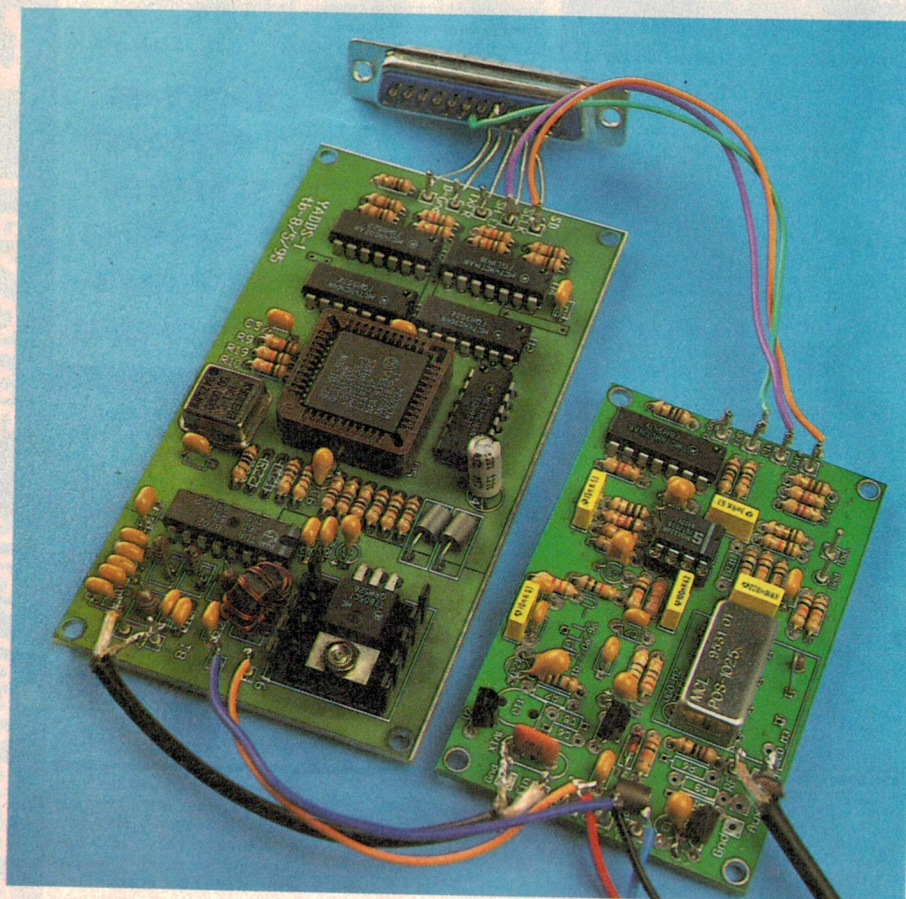
The YAPPL-V and YAPLL-U are both complete PLL modules, covering the HF, VHF and UHF frequencies in one octave band each (a 2:1 frequency coverage), starting from 25MHz and reaching up to 1000MHz. The RF output level is +7dBm, which is suitable to drive a diode mixer directly.

The spectral purity of the modules is excellent. The only measurable discrete frequency components of the output signal are the harmonics of the fundamental, with the low order harmonics typically 30dB down. Phase noise depends on the actual VCO module used, and varies from -112dB/Hz at 10kHz offset for the 25 - 50MHz version, to -90dB/Hz at 10kHz offset for the 600 - 1050MHz version. If an external, low noise VCO module is used (for example in a narrow-band application), these figures can be much better.

The desired output frequency from either module can be programmed from a PC through a three-wire serial interface. The switching time is typically 1ms.

The PLL modules are essentially built around the recently introduced Mini Circuits POS series of VCO blocks. These affordably priced VCOs are easy to use, yet perform surprisingly well considering their small physical size.

For added flexibility the UHF PLL module has provision to use two other types of VCO modules as well, thus improving either the close-in noise performance of the output signal in narrow band applications, or extending the frequency coverage up to 2GHz. For narrow-band applications in the 400 - 500MHz frequency range, the Murata MQC-403 series VCO modules can be used. Similarly frequencies above 1GHz can be generated using the Synergy 'VCO-P-xxx' range of VCO's. The YAPLL modules can thus be used as an evaluation platform to test any of these commercial VCO modules.



Visible here are one of Tibor's YAPLL-U modules (right), connected temporarily to one of his YADDS-1 frequency synthesiser modules. Together they provide a PC-controlled UHF frequency source, of high frequency resolution and with low spurious output levels.



## PLL Modules

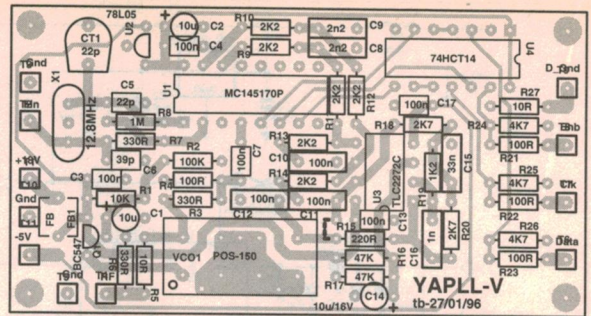
type termination — as here — is to use only the HCT version of the 74HCT14 Schmitt trigger IC, or an 'old' LS type. The 74HC14, as used in some other designs, can be used only if the terminating resistors of the printer cable are connected to the +5V line.)

The YAPLL-V module requires stable DC supplies of +18V and -5V. The positive supply can be raised to 24V if required, to squeeze out a few more MHz from the VCO at the top end of the tuning range. D1 clamps the minimum tuning voltage applied to the VCO module to a safe -0.5V. Current consumption is less than 50mA from the 18V rail.

Transistor Q1 is required to provide a clean and noise-free supply voltage for the VCO block — any noise in the supply line would show up as undesired frequency modulation at the output. If higher DC voltages are applied at the +18V terminal, the value of R2 should be adjusted to set the supply voltage for the VCO module. Resist the temptation to replace this resistor with a Zener diode — the noise sidebands of the output signal may be degraded by up to 20dB if you do!

It is possible to use a single supply rail for the YAPLL modules. In this case the -5V terminal is connected to ground and a low noise, high input impedance, rail-to-rail output device is used for loop filter chip U3. Suitable op-amps to use are the TLC2272CP or LMC6032A. However note that as these are CMOS devices, the maximum supply voltage that can be

**Fig.2: The overlay for the YAPLL-V module. Like the UHF module, it can be wired to use either a crystal X1 as the PLL's frequency reference, or the output from Tibor's YADDS-1 synthesiser module.**



applied is only 16V; do not be tempted to go above this figure, otherwise you will be greeted by a puff of blue smoke. The full supply voltage swing is available to drive the VCO block in this case — a typical application is running the YAPLL modules from 15V DC.

The loop filter values shown around U3b are optimised for a reference frequency of 200kHz. Good results will be obtained for any value in the 100kHz to 400kHz range. The output frequency settles to a new value in about 1ms. If the module is used in stand-alone applications and other than a 200kHz PLL reference is used, the loop filter values will have to be changed accordingly.

U3a forms an additional active low-pass filter for the loop error signal, which removes the tiny modulation sidebands (-80dBc) caused by the PLL reference frequency reaching the VCO control pin. The inverting configuration ensures that the common mode voltage range of the op-amp inputs is not exceeded. The corner frequency of this additional filter is 20kHz for the component values shown, which is suitable for

a 100kHz PLL reference.

There is provision on the board to bypass this stage by fitting resistor R15 upright along the dotted lines (Fig.2). In this case the phase detector polarity in the configuration data byte of the MC145170 (MSB, or bit 7 of the eight-bit 'C' register) has to be inverted.

If the board is used as a stand-alone PLL module, XTAL1 provides the necessary reference frequency. The reference divider inside the MC145170 can be programmed to any integer value, thus any typical PLL oscillator crystal can be used: 10.240MHz, 10MHz, 6.4MHz or 12.8MHz. Note that PLL crystals usually have a much better frequency stability than cheap 'computer grade' ones, but this quality is reflected in the price — you usually get what you pay for...

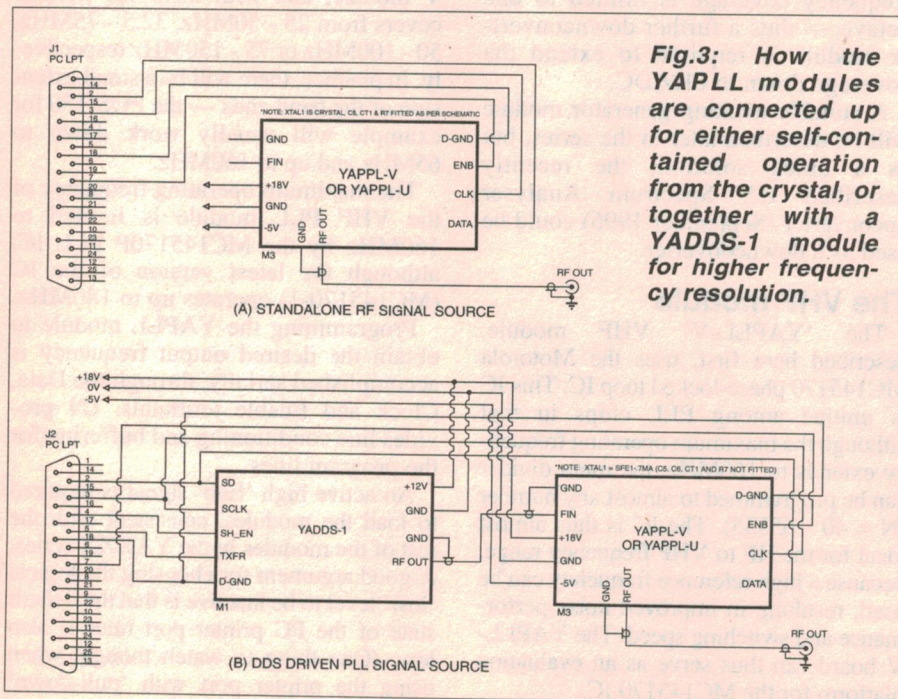
When an external DDS signal source is used for reference, the crystal is replaced by a 10.7MHz ceramic filter. In this case R7, C5, and trimmer CT1 are not fitted. The DDS-derived reference frequency for the PLL can then be set to any frequency in the pass-band of the ceramic filter — typically +/-90kHz from the centre frequency — providing fine frequency steps on the output of the PLL module.

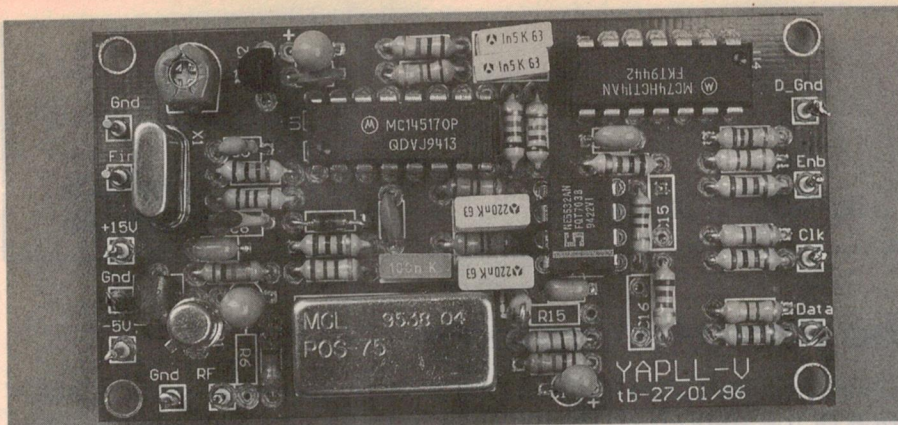
The ceramic filter removes the bulk of the DDS noise and spurious signals, so the signal purity of the PLL module is not degraded. In fact the combination provides a very clean output, combined with fine frequency steps and fast frequency settling. The block diagram of a DDS-driven PLL arrangement is shown on Fig.3(b), with the stand-alone PLL configuration shown in (a).

### The YAPLL-U module

The UHF module is similar to the VHF one — see Figs.4 and 5. It uses the UHF versions of the Mini Circuits VCO blocks, but as noted earlier the PCB has also been designed to accept two additional types of VCO block: a Synergy VCO-P-xxx or a Murata MQC-403-xxx. The range of Synergy VCO blocks (available from Electronic Development Sales) will cover a wider frequency range than the Mini Circuits ones, at the same time offering a

**Fig.3: How the YAPLL modules are connected up for either self-contained operation from the crystal, or together with a YADDS-1 module for higher frequency resolution.**





slightly better noise performance. The Murata MQC-403 or MQC-404 (IRH Components) are ideal for 400 - 500MHz narrowband applications, due to their superior phase noise performance (specified as -117dB/Hz at 20kHz offset). The Mini Circuits blocks are of course available from Clarke & Severn Electronics.

The PLL IC used in this module is the Motorola MC145191. It is a dual-modulus single chip PLL device, which nominally operates up to 1.1GHz. (For operation up to 2GHz a pin-compatible MC145201 can be used.) The tri-state charge pump output of the chip's phase comparator is used here, as the maximum output current can

be programmed through software between 25% and 100% of the preset value. This is an effective way of controlling the loop filter dynamic behaviour without tweaking component values. The nominal output current is set by resistor R28.

As with the VHF module, U3b is used as an active loop filter, while U3a provides additional reference signal suppression for the loop error signal. Note that only one of the resistors, R31 or R32 must be fitted: fitting R32 and leaving out R31 enables the active LPF, while fitting R31 (and not R32) bypasses it.

The supply voltage for the PLL IC is provided here by two +5V regulators. At

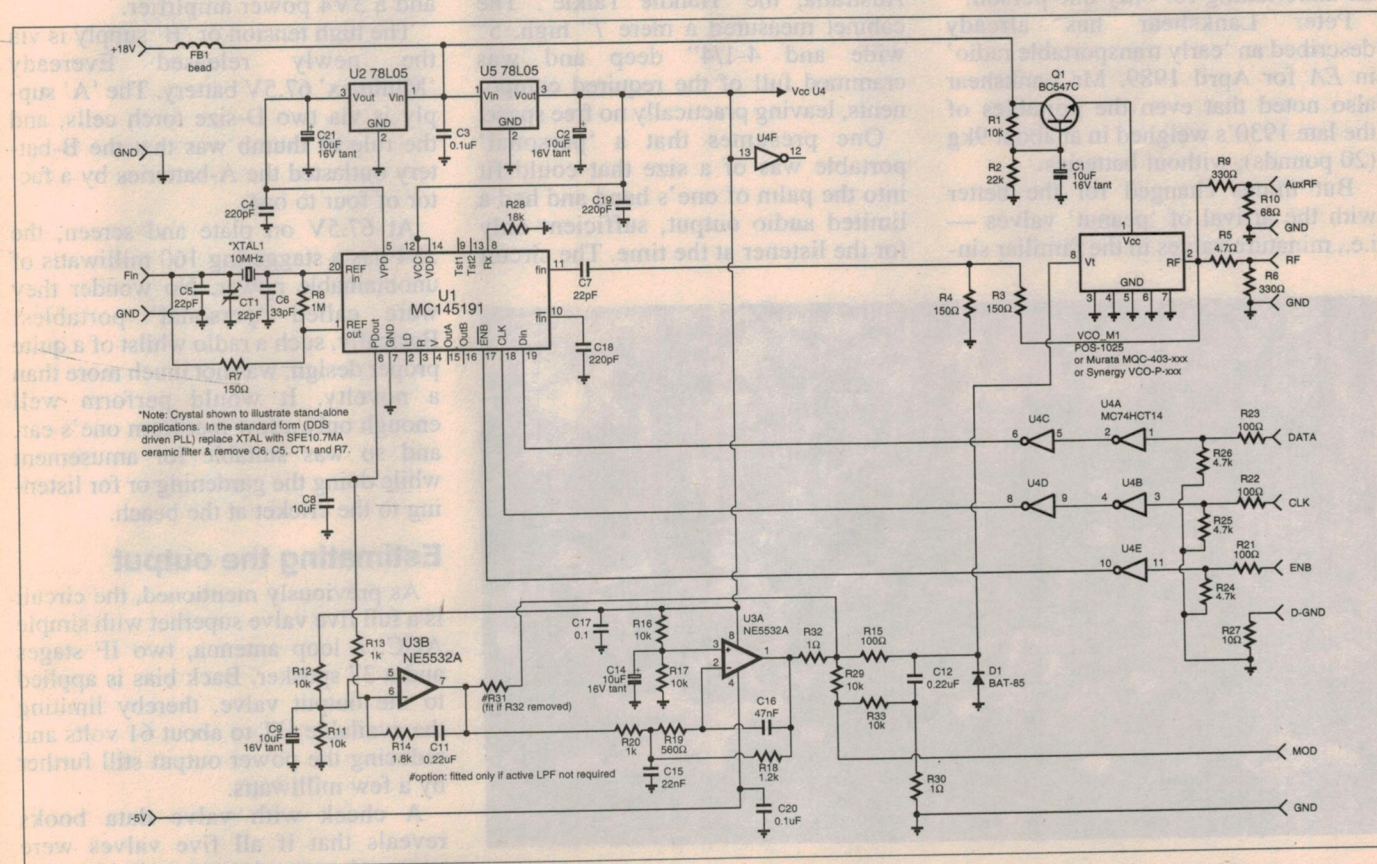
**A close up view of the YAPLL-V module, giving a good idea of where everything goes on the PCB.**

first, this may seem redundant, but it allows the MC145190 to be used on the same board as well. This IC will accept a 'charge pump' supply voltage ( $V_{pp}$ ) up to 9V, increasing the available VCO control voltage range if a passive-type RC loop filter is used. In this case, U2 is replaced by a 9V regulator and U3 is not fitted.

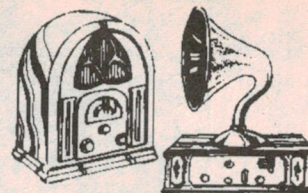
The YAPLL-U module has an added FM modulation port, which allows advantage to be taken of the reasonably linear tuning characteristics of these VCO blocks. The resulting FM deviation will be fairly constant across the band, but will of course vary from VCO to VCO as the main tuning sensitivity varies. The modulation frequency response is flat above the PLL natural frequency — thus for the component values shown (the PLL being set up for a fast switching speed), the response will drop by 12dB/octave below approximately 2kHz. If a flat response down to 20Hz is required, the loop has to be slowed down accordingly.

The UHF module has two RF outputs: the main one providing around 7dBm of

*Continued on page 98*



**Fig.4: The schematic for the YAPLL-U module, which is similar to the VHF module but is based on the Motorola MC145191 chip. This module can also use a number of VCO modules.**



## Multum in parvo — the Personal Portable

The advent of the corded and cordless headset type of radio and the euphemistic 'ghetto blaster' have largely seen the disappearance of the hand-held portable, or 'trannie' as they were so often called. In the valve radio days, the equivalent was known as the 'personal portable'.

There has always been a fascination for radios that can be moved — i.e. portables — firstly among enthusiasts, and subsequently the general public. Fig.1 shows an outing of Southern Suburbs Radio Club (S.A.), who took their radios on a train trip through the Adelaide Hills in 1925. Such an undertaking was strictly for the enthusiasts, though. Carrying a heavy accumulator, a loop aerial, a horn speaker, battery packs and skeins of connecting wires is not a particularly user friendly activity, nor an undertaking for only one person!

Peter Lankshear has already described an 'early transportable radio' in *EA* for April 1989. Mr Lankshear also noted that even the portables of the late 1930's weighed in at about 9kg (20 pounds), without batteries.

But things changed for the better with the arrival of 'peanut' valves — i.e., miniature valves in the familiar sin-

gle-ended guise. Released in 1940 by RCA in America, they did not appear in this country until at least 1946.

*EA*'s forerunner *Radio and Hobbies* published details of a portable set using the new valves in October 1946. It was housed in what was a otherwise a standard portable cabinet and chassis, and using regular components.

### The truly portable

In October 1947, *Radio and Hobbies* published what they claimed was the first truly personal portable in Australia, the 'Handie Talkie'. The cabinet measured a mere 7" high, 5" wide and 4-1/4" deep and was crammed full of the required components, leaving practically no free space.

One presumes that a 'personal' portable was of a size that could fit into the palm of one's hand and had a limited audio output, sufficient only for the listener at the time. The circuit

is produced in Fig.2, and a photograph of a disassembled version is shown at Fig.3.

Many pages were devoted to the construction, which called for a good deal of inventiveness, patience and dexterity — and dare to say, a small soldering iron with resin cored solder. As can be seen from the circuit, there are no short cuts. It is indeed a full five-valve superhet with simple AGC. The circuit uses a 1R5 as the converter, two 1T4 IF amplifiers, a 1S5 for detection and first audio amplifier and a 3V4 power amplifier.

The high tension or 'B' supply is via the newly released Eveready 'Minimax' 67.5V battery. The 'A' supply is via two D-size torch cells, and the rule of thumb was that the B-battery outlasted the A-batteries by a factor of four to one.

At 67.5V on plate and screen, the 3S4 has a staggering 160 milliwatts of unobtainable power. No wonder they were called 'personal' portables! Basically, such a radio whilst of a quite proper design, was not much more than a novelty. It would perform well enough only a few feet from one's ear, and so was suitable for amusement while doing the gardening or for listening to the cricket at the beach.

### Estimating the output

As previously mentioned, the circuit is a full five valve superhet with simple AGC, a loop antenna, two IF stages and a 3" speaker. Back bias is applied to the output valve, thereby limiting the available HT to about 61 volts and reducing the power output still further by a few milliwatts.

A check with valve data books reveals that if all five valves were operated at maximum available voltage, the total current drain would be a hefty 20 or so milliamps. Screen



Fig.1: Taken from the *South Australian Wireless and Radio Weekly* for October 21st 1925, this picture was taken on the SSRC train picnic to the Adelaide Hills.

dropping resistors R4 and R5 would ensure that the 1R4's and the 1S5 would be tamed considerably, thereby limiting HT consumption to about 9mA — still more than enough for the small B-battery. The *Radio and Hobbies* article itself gave no information regarding the circuit's current consumption.

## Commercial designs

Looking more like a fridge for a doll's house than a radio was the AWA 450P for 1948. This design uses four valves, with only one IF stage. By then newer high gain intermediate transformers were available. The AWA set used a non-miniature tuning gang! Current consumption was stated at 6.5mA, not including the 1R5 and 3S4 screen, which would amount to a further 2.5mA.

Also for 1948 was a Breville type 801 using five valves. This design had a tuned aerial stage and an untuned RF stage, because miniature three-gang tuning capacitors were not considered. Healing produced the 404B for the same year using four valves, and an equivalent Hotpoint Bandmaster was manufactured by AWA. From time to time other manufacturers made forays into the personal portable market, but the total numbers made are unknown.

## Repairing a portable

Repairing one of these gems

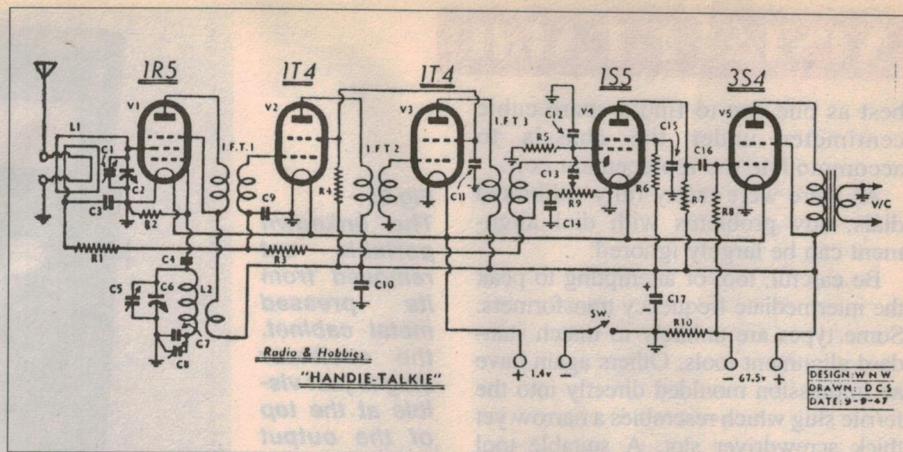


Fig.2: The circuit of the 'Handie Talkie' personal portable described in *Radio and Hobbies* for October 1947. It was designed by Neville Williams.

requires a few tricks of the trade. Firstly, the aerial coil is rarely a conventional coil. It is more likely to be a loop antenna, either fixed to the inside of the cabinet or wound around the outside of the cabinet and then covered with leatherette. In the event that extension wires are required once the chassis is removed, keep them as short and as widely spaced as possible for fear of alignment problems.

If access to a bench supply is convenient, about 70 volts will be required. The 'A' batteries can be conveniently replaced with modern counterparts, with alkaline types being preferred. Ensure that any residue from old leaking batteries

from former times is removed as thoroughly as possible, but DO NOT use steel wool. The fine dust produced as a result of using steel wool can cause havoc. A nylon type scourer is the only choice.

Because of the cramped underchassis, it may be necessary to remove the odd capacitor to gain access to valve bases, in order to measure voltages. Of course, they are replaced again afterwards.

The oscillator coil may be wound around the oscillator grid leak resistor, and is generally wound with very fine wire. In the event that it becomes open circuit, replacement can be difficult. You may have to find a more modern, small counterpart and try as



Fig.3 (left): The component parts for the R&H Handie Talkie portable. Not shown are the set's batteries.

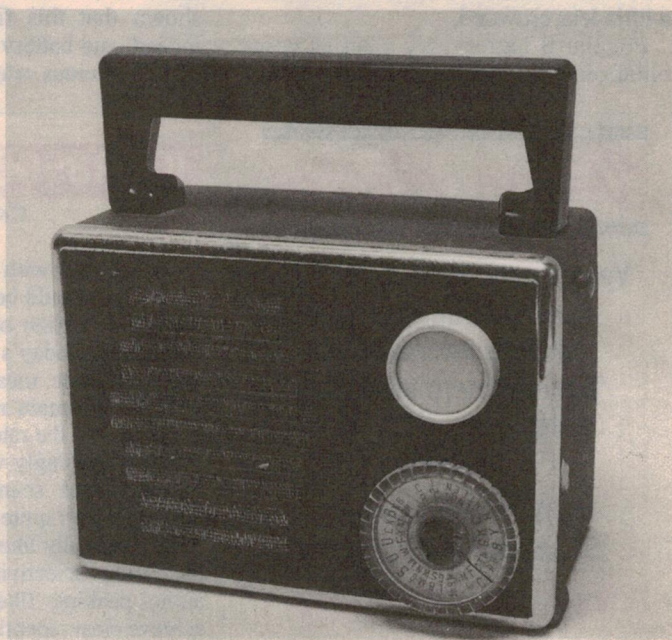


Fig.4 (right): This early valve portable is as yet unidentified. The loop antenna is contained in the handle, which must have made for interesting listening!

## VINTAGE RADIO

best as one can to find a spare cubic centimeter under the chassis to accommodate the replacement coil.

As there were rarely fully calibrated dials, any problems with dial alignment can be largely ignored.

Be careful, too, of attempting to peak the intermediate frequency transformers. Some types are unlikely to match standard alignment tools. Others again have an impression moulded directly into the ferrite slug which resembles a narrow yet thick screwdriver slot. A suitable tool can be fashioned from a knitting needle.

Do not try and force a sticking slug; apply gentle pressure. Otherwise the slug may crack, thereby seriously affecting alignment and performance. Chances are that the IF transformers won't be too far out, and it is better to err on the side of caution.

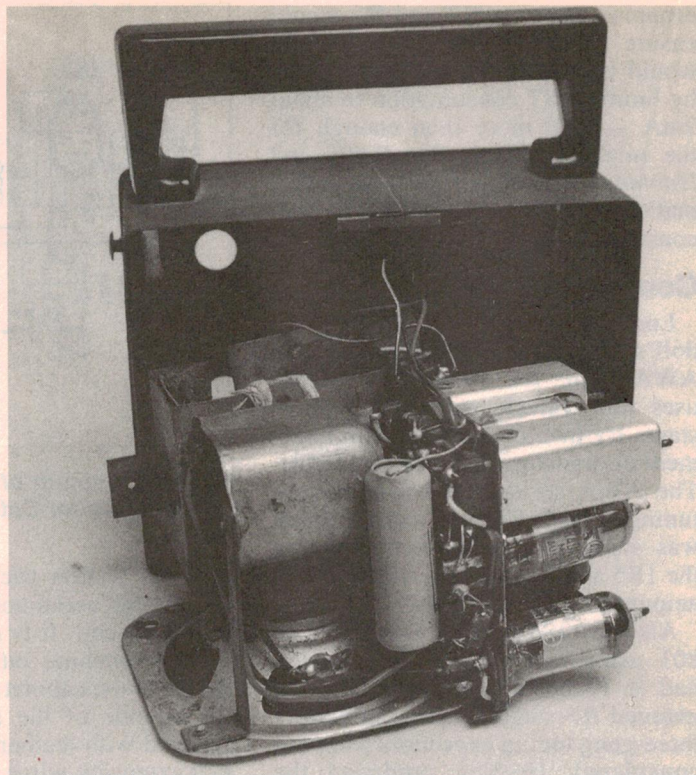
Basically, alignment consists of a tweak of the padder or oscillator slug, and a peak of the aerial trimmer. There may or may not be an oscillator trimmer to worry about!

### Spare parts

In the event of a dud valve, a replacement can be easily obtained from one of the vintage radio specialists who advertise in this magazine. Resistors and capacitors, if needing replacement can be done so with more modern equivalents which are usually physically smaller, and hence the under-chassis will become a little less crowded.

For the B battery, try a series combination of eight 9V miniature (216)

**Fig.5:**  
*The unknown portable set removed from its pressed metal cabinet. the oscillator slug is just visible at the top of the output transformer, and the space beneath the transformer housed the B battery.*



types. These can be connected using snap-on connectors and with a little ingenuity, taped together to fit into the space previously occupied by the old 67.5 volt type. The 'A' batteries can be modern D size alkaline types.

Modern 9V batteries have a nominal rating of 0.11Ah. This means that at 8 or 9mA consumption, the batteries will last 14 to 15 hours. However experience has shown that this figure is conservative indeed, and battery life depends as much upon judicious use as anything else. If

the radio is used for no more than one to two hours at a time, and an equivalent recovery time is allowed, the battery life could easily be doubled. The better quality the battery, the longer the life.

Finally, anyone fortunate to have one of these little gems will know what a great conversational piece they can be, even amongst non-technical folk. A small 'vintage portable' radio will be a great hit at a barbecue or dinner party, and they are worth the trouble of restoring. ♦

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## IC-R8500 Receiver

*Continued from page 9.*

when coupled with suitable antennas, the IC-R8500 should be capable of providing reliable reception of virtually any usable signals, in today's noisy and cluttered spectrum. The measured selectivity figures for the main reception modes were very close to the rated figures.

Not surprisingly we found the memory facilities and scanning functions very powerful, and quite easy to use. But best of all, we really liked the ease with which the various selectivity modes, IF shift and audio peaking filter could be used to achieve clear reception of even quite weak signals on the crowded international broadcasting bands.

We didn't get a chance to try hooking up the receiver to a PC, but from past

experience with other Icom receivers this should provide a very worthwhile feature for those who can use it to advantage. In this case the ability to use either the CI-V or RS-232C interfaces is undoubtedly an added bonus.

In summary, then, we found the Icom IC-R8500 an excellent wideband communications receiver, combining full MF/HF/VHF/UHF coverage with virtually all of the facilities and performance for serious reception. It seems to us to represent good value at the quoted RRP of \$3763, with the FL-52A CW narrow IF filter option a further \$260 and the CR-293 high stability crystal option a further \$298.

For further information on the IC-R8500, contact your nearest Icom dealer or Icom Australia, 7 Duke Street, Windsor 3181; phone (03) 9529 7582 or fax (03) 9529 8485. ♦

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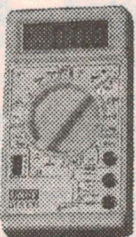


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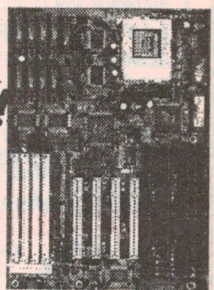
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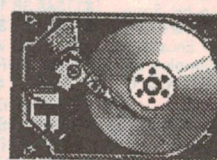
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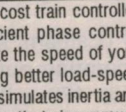
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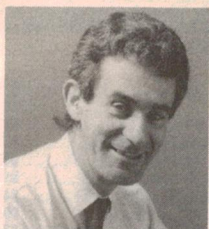


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# INFORMATION CENTRE

by PETER PHILLIPS

## ***That star puzzle, solar power and more***

We start this month with reader letters about that very popular October star puzzle. Then we describe a device that gets rid of spiders by EM radiation, and present a letter from a reader defending his solar power installation. There's also letters about an automatic pet door, transformer testing, reversing video tapes and so on. And to keep you busy over the New Year holidays, there's two What?? questions.

I'm now wishing I'd kept a count of all the letters and faxes I've received about the October star puzzle (sent by Linden Beswick). While I've already given one of the possible answers last month, I thought you might enjoy some highlights from the letters about this puzzle. As I said last month there are 960 solutions, of which 80 are unique (not mirrors or rotations).

Most people wrote a computer program to solve the puzzle, including Ian Bruckshaw and son Andrew:

*I enjoy the puzzles in your section. Using HyperCard on a Mac SE/30, we found 390 solutions to the puzzle. We built a stack which allowed us to manually change values at the intersection by clicking on them with a mouse, with the totals automatically added. If anyone would like a copy of the stack, please phone Andrew on 041 950 2416. (Ian Bruckshaw, Anula, NT)*

Ian also sent a printout of his 390 solutions, and like many others, took the opportunity to send me an answer to the October What?? question (the incorrectly marked drawers). It seems this problem was nearly as popular as the star puzzle.

Richard Delahoy (North Dandenong, Vic) also used a computer program to solve the star puzzle, commenting in his fax:

*Here's a solution to the star puzzle. Tell Linden Beswick not to feel bad taking a couple of years to solve it—it took my 120MHz Pentium quite a few hours to work out the result.*

Dr Andrew Stuchbery (Latham, ACT) also used a computer, pointing out that there are 12-factorial (or 479 million) ways of putting the numbers 1 to 12 into the star. If 1 is assigned a particular spot, there are still around 40 million possibilities for the remaining numbers, so the

odds are heavily against getting a solution (about 160 in 40 million). I said last month that given the number of possible solutions, the problem should be easy enough to solve. Which was foolish, as I hadn't figured out the number of possible entries...

But then, according to Mr R. Gebhardt, of Mt Bryan in SA: *Your puzzle took my wife about 10 minutes to solve!* One for the ladies, it seems; although Mr R. D'Andrea (Dandenong, Vic) chided himself for taking 30 minutes. Ian Firms, age 14, got an answer in about half an hour, saying in his letter how he is captivated by the problems posed in the column. Roger Turner from Coober Pedy (SA) says he took five minutes—the record so far.

It took Charlie Worsfold (Spence ACT) *...a few hours of trial and error, a few cups of coffee, a few cigarettes and several sheets of paper.* And thank you, Charlie for the two additional questions you've sent; I'll be presenting these over the next few months. Alan Cooper (Thornlie, WA) spent five hours on the problem: *30 minutes to write the program, 30 minutes to debug it and four hours execution time. Phew!*

Stuart Arblaster (Cooranbong, NSW) appears to have used a computer program, as he sent me all 960 solutions, occupying 14 tightly printed pages. John Day (Stafford City, Qld) also sent me all possible solutions, on a 15-page printout. Thanks Stuart and John; surely the definitive answer.

But there are manual methods. For instance, according to Clyde Muirden (Everton Park, Qld): *The trick is to begin by creating a triangle whose sides all come to 26, then fitting in the three remaining numbers.* Kevin Douglas (Ceduna, SA) also used this method. Or, as Bill Metzenth

(Ormond, Vic) wrote:

*On the surface the problem looks interesting, but as it doesn't have much structure, it didn't turn out to be all that interesting after all. A simple way to solve the problem is to note that only two of the six lines in the puzzle as presented have a sum which is not 26. We can fix one of these sums by performing two interchanges, that is swap the 5 with the 8, and the 7 with the 3. This gives an arrangement which still has two lines with a sum that is not 26. However, a single interchange now gives the solution—i.e., swap the 6 with the 9.*

Quite a few readers used a spreadsheet to solve the puzzle. John Dragt (West Moonah, Tas) used a spreadsheet on his Amiga 600, saying *It seems my 1MB machine is still good for something!*

A number of people used Excel, including Ian Davidson (Mitcham, Vic) who writes: *The first thing I did was check that the problem had a solution. The sum of all the numbers in the stars is 78. Doubling this, because each number is used twice in the puzzle gives 156, and dividing by 6, because there are six lines to complete, gives 26, same as the line total we want. I then used trial and error—with a little help from my friend Excel—and after 10 minutes came up with an answer.*

Hmmm. I don't know about the checking method, as each number is used only once, but Ian's answer was certainly correct. And thank you Ian, for sending me some more What?? questions. I'm presenting one this month.

In fact for me, one of the best outcomes of this has been the number of potential What?? questions readers have sent. Also, thank you everyone for your supportive comments about the column. It's good to know readers enjoy the

magazine, and in particular the What?? (and other) questions I pose.

There are many more letters, but I've saved what I think is the best until last. While many people wrote a computer program to solve the problem — in C, BASIC and so on — I wonder how many people thought about making the puzzle into a computer game. This is what 'The Guys' from Esperance (WA) did, who also sent me a disk of their Windows 95-based program.

The screen dump in Fig.1 shows how the 'game' appears. Just slide numbers from the bar on the left to a node on the star pattern. When a line adds up to 26, it changes colour. The values in the boxes around the star give a running total. You can print the result, with the printout showing the star pattern and the numbers you've entered. Clever!

I've written to 'The Guys' (Alex, Colin and Lorna) asking if we can make the game available via our bulletin board — although they might decide to make the game into shareware or similar. I'll let you know.

But don't go away! Given the popularity of the problem, here's another one (Fig.2), sent to me by Kim Nelson (Greenfield Park, NSW) in his fax containing an answer to the original problem. All you have to do is make each line add up to 25 using, once only, each number from 1 to 14. Kim supplied an answer, which I'll give next month. Thanks Kim.

Finally, I believe I've written to everyone who sent an answer (unless no address was given); but in case I've missed anyone, my sincere thanks to you all.

## The computer saga

You might be wondering how things ended with my Toshiba computer system. As you've probably read, I introduced the column in November and December by describing a situation that I felt needed to be aired. In summary, I had purchased an expensive Toshiba laptop computer and docking station, only to find it did not perform to specifications.

Given that the dealer was not a certified Toshiba Technical Centre (something I did not realise would be so important), I wanted Toshiba to send a technician to my office, as I believed the equipment was faulty.

However, I mentioned last month that Toshiba had advised me I would be receiving a new docking station. It has now arrived and appears to have fixed most of my problems. Although it is nominally the same model as the unit it

replaced, when I fitted the laptop to the new station, Windows 95 saw it as a completely different installation — which suggests the changes to the new unit are quite significant compared to the old. Interesting...

There are still a few outstanding issues, but at last I'm able to use the system with some confidence. Toshiba, in their latest letter have reiterated their stand, which is: *The normal process for resolving such problems is for the equipment to be returned to an authorised Toshiba Service Centre.* The letter also states that: *Notwithstanding your difficulties, Toshiba has always extended support beyond what is normally expected in the industry.*

You can make up your mind about this last sentence, but I repeat my warning: make sure you purchase any computer system from someone able to give technical support. I'll leave it rest at that, as I've done what I set out to do. That is, I wanted to publicise what happens when you are unlucky enough to buy a name brand system that has a problem. Now to some letters...

## Video tapes

I've never thought about this, but it makes sense:

*Has anyone figured out a way of physically reversing the tape in a video cassette? Video tapes get used much more frequently near the start, and in order to balance out the wear it would be good to reverse the tape in the casing. However it is not a simple matter, because of the shape of the drums.* (David Timmins, Randwick, NSW)

This is something I've not tried, although I've repaired broken video

tapes a few times. As a suggestion, you could cannibalise an old video tape cassette by removing and junking the tape. Then arrange the two cassettes so the tape you want to reverse can be wound into the now blank cassette. Obviously you'd need to wind the end of the tape to the feed spool, instead of the take-up spool. Tricky, but it's all I can think of. I'd welcome any other suggestions.

## Transformer testing

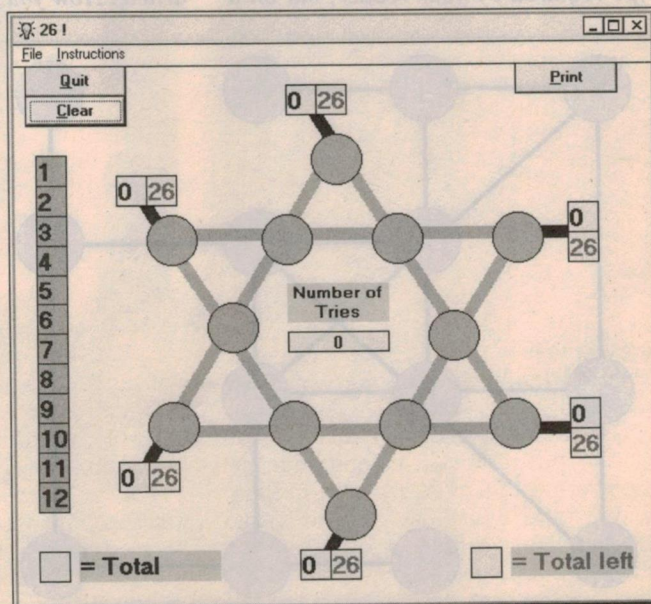
In July a reader described a way of testing a transformer to identify its primary winding. The trick was to supply 6V AC to the easily identified secondary and to measure the voltage at the other windings, thereby locating the primary winding.

I added a few comments, including making a point of inserting a fuse between the source voltage and the transformer under test. I suggested a 1A fuse, but this might be a bit light on as the next letter explains:

*Just a short note on transformer testing from its low voltage side. You suggested inserting a 1A fuse in the source circuit. This could be rather misleading, as the magnetising current on a 6V winding can easily exceed that value. The turns ratio to the 240V winding is nearly 40:1, so the current will also be 40 times the normal primary current. Even on a 70VA transformer the 240V magnetising current is typically 40 to 70mA, so we are talking about a current of 2A or so on a 6V winding at a supplied voltage of 6V. You would thus need at least a 3A fuse, and even that could be blown by the inrush current.*

*The alternative, and a much safer method, is to apply about half the rated*

**Fig.1: This is how 26! (the game) appears on the screen. You slide numbers from the bar on the left to the star to get each row to add up to 26.**



voltage, where the current is very much lower and less peaky. The design voltage of the other winding can still be calculated, and if there is a fault, such as shorted turns, it will show up even better than at full voltage. (Charles Borger, Pascoe Vale, Vic)

I agree with you, Charles. After reading your letter I did a few tests in my workshop with a typical 50VA (or so) transformer. Its primary no-load current measured around 120mA when supplied with 240V AC. I then connected a 7.5V AC source to this transformer's 7.5V secondary and measured a no-load current of over 1.8A. When supplied with 4V, this current was around 0.7A, less than half the previous value. So clearly a 1A fuse is not suitable. A 3A or even a 5A fuse would still give adequate protection, yet still blow if there was a short somewhere in the setup.

## Pet door ideas

In October I presented a letter from a reader (P. Hutchings, of Palmerston North, NZ) suggesting we look at designing a project where an implanted IC in a cat or dog would allow that animal, and only that animal, access through a specially designed pet door. I replied by saying that while in principle the idea seemed sound, I doubted the practicalities, with visions of animal surgery being carried out by well-meaning hobbyists. But it seems there are other ways of going about this:

*I have designed (and our cat Ching has successfully used) a pet door of the type required by your reader, but on a*

*much simpler scale.*

Briefly, Ching has attached to her collar a magnet taken from a door-mounting reed switch (ex Dick Smith). An array of two such reed switches is mounted under a platform adjacent to the door, in such a manner that Ching triggers the reed switches when she attempts to push the cat door open.

When operated by the magnet, the reed switches trigger an EA timer (you could use a 555 timer, but I had an EA timer to hand), which throws a relay to operate a simple solenoid device, which unlocks the door. The timer holds the solenoid for about 11 seconds, long enough for Ching to enter with her usual unhurried aplomb. Very cheap and totally effective.

The magnet on the collar doesn't worry her, and has only rarely been lost. The device has worked for several years now with no problems, and has caused endless bewilderment among neighbouring cats intent on knocking off our expensive cat food. Of course any cat with a magnet could gain entry, but they haven't figured that out yet. (John Boddington, Woonona NSW)

What a good idea, John. A magnet, particularly a rare earth magnet, can be very small yet strong enough to operate an appropriately placed reed switch. A timer, a solenoid and you've got it.

While John's idea is tried and tested, here's another suggestion that seems as though it should work:

Reading through the EA September 1996 issue, I came across Tom Moffat's article: How you get busted for shoplift-

ing. The article describes a number of anti-theft systems, including one that uses a tiny UHF antenna, tuned to 900MHz. The antenna has a diode connected across it, which causes the antenna to re-radiate at twice the received frequency.

It occurred to me that this scheme could be used to operate a pet door, by attaching the antenna to the pet's collar. It could then be made to trigger a receiver that opens the pet door. This gets around the need to inject the pet with ICs. (Gavin Rogers, Duncraig WA)

This seems a good idea, but I suspect it has a few difficulties for hobbyists who don't have access to UHF measuring equipment. As Tom explains in his article, he was not able to get information from manufacturers, so it could be there is quite a bit of design in the system. But the idea sure has merit.

And for the last word on this topic, here's a letter from the original correspondent, who also seeks advice about another matter.

## Car amp booster

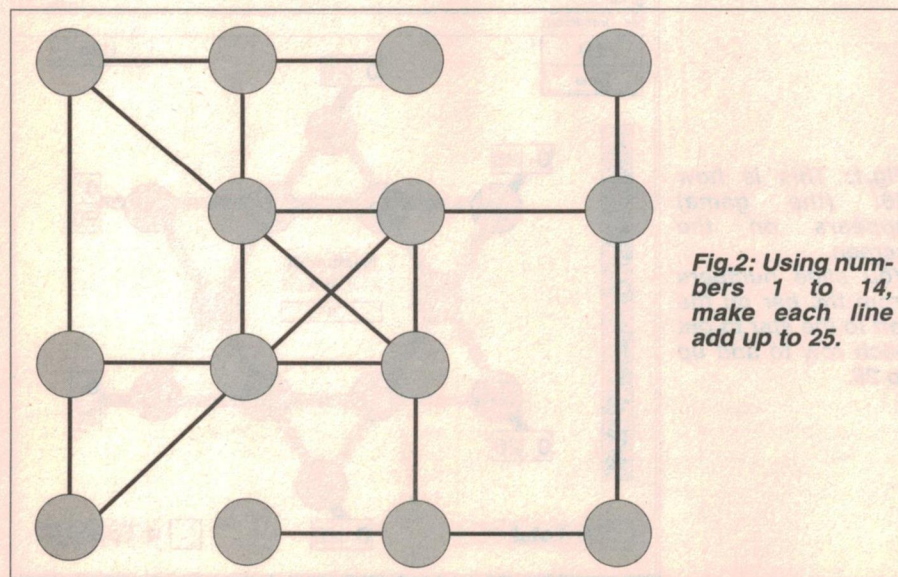
In regard to your reply to my letter in the October issue, chip implanting for identity purposes is carried out quite often by vets. A small glass encapsulated chip is injected into the back of the neck. I'm not sure of the size of the IC, but it's likely to be very small.

On another matter, I am wondering about the design of a power supply that uses a DC to DC inverter to supply a stereo amplifier in a car. The aim is to increase the output power of the amplifier over that available from 12V DC. There are a number of kits available for 25W to 50W amplifiers, which could possibly be used as the amplifier in the car.

I am currently experimenting by adapting an inverter used in a CDI unit presented in EA some years ago, and have in mind two 20W amplifiers from the November 1984 issue, but have yet to complete the project. (Peter Hutchings, Palmerston North NZ)

I assume an identity IC could be used as the trigger for a pet door, Peter, but I must confess that I much prefer John Boddington's method. Regarding your enquiry about an inverter, we have presented a number of designs over the years.

Those that might suit you, if only for ideas, include a 12/240V inverter (15W, for portable CD players etc) in April '87; a 40W inverter (for small appliances) in August '85; and a 12/240V



**Fig.2: Using numbers 1 to 14, make each line add up to 25.**

inverter (40W) in May '82. We also published a design for a 100W car stereo amplifier in August and September 1985.

## Alternative power

In July '96 I included a letter from a reader (John Denham) describing the alternative energy system he has installed in his property. The system cost over \$30,000, and includes quite a range of equipment — more than necessary according to another reader (Chris Johnson-Walker) in a letter in the October '96 issue. Chris also pointed out that John had not mentioned a government grant he had received towards the cost of the system. He went on to say that a typical grant could more than cover the cost of a system, depending on the honesty of the consultant.

Chris also explained that a suitable system could be had for around \$13,000, and justified this with a cost breakdown of the various components.

As you'd expect, John has sent a letter responding to the issues Chris raised. Here's his letter:

*I read with interest your correspondent's letter. He is wrong about NSW RAPAS rebates. I did not disclose anything about this as it was irrelevant. In fact we received the maximum \$8000 rebate. The scheme, I believe, ended on 30 June 1996, and there is now no rebate available.*

*The situation quoted by your correspondent, of padded costs to get higher rebates, ended before we started on our system and resulted in the restricted rebate system from which we benefited. The rebate we did receive was effectively reduced by the added costs of meeting some of the stringent RAPAS requirements (introduced with the restricted rebate system), plus the cost of inspection.*

*I am not sure what the comments about welders mean. Contrary to his statement, a cost/benefit analysis was done — but this involved meeting our specific needs, not just "a reasonably user transparent system", whatever that means.*

*The rest of his comments propose the sort of system which we seriously considered, and this may well suit other readers.*

*We followed your correspondent's philosophy for two years when we were living in a caravan, so we have tried it. After this experience, we preferred for our house installation to stick with electric refrigeration to avoid introducing another fuel, with its installation and ongoing costs. As well the choice of gas refrigerators/freezers is very restricted, and they generate considerably more heat than compressor types, a factor we*

*needed to consider given summer temperatures of 40° or more.*

*His reliance on frequently using a generator was not suitable for us, as our experience showed petrol generators to be expensive to run (fuel and maintenance), and unreliable with high usage. Diesel generators, while more reliable and cheaper to run are much more expensive to buy and overhaul. Both are noisy, and we needed to have a system which would reliably maintain power while we were away for weeks or months at a time.*

*We cannot agree with his suggestion that we have excessive battery capacity. We have had to use the generator several times last winter, when there were five or more cloudy days in succession. The aim of a dual system was to provide a system which could continue if any major component broke down. The Selectronics inverters are capable of running all our power requirements individually, except perhaps in very hot weather. (John Denham, Elong Elong, NSW)*

Thanks for responding, John. Anyone considering an alternative energy system now has both sides of the argument, from two obviously experienced people. So if you're thinking about such a system, you might like to read the July and October letters to get a more complete picture of what you're in for.

## EM pest killer

The effects of electromagnetic (EM) radiation have occupied the media for some time, including considerable discussion in this column. But it seems there is an upside: to get rid of bugs and pests. Well — I'll let our next correspondent explain.

*I've enclosed a recently published advertisement of a product that claims to get rid of spiders and pests by way of EM radiation. So, far from denying the harmful effects of this type of radiation, here we have a company promoting its effects as beneficial. With a power consumption of only seven watts, it appears this product will make an entire house uninhabitable for all occupants except humans and pets. Wow!*

*I'd be tempted to try one, except I don't have any bugs (except in my programs), and I'm not silly enough to part with \$79. (John Freeman, Little River, Vic)*

Wow indeed! The advertisement John sent claims the field from the device will penetrate deep into wall cavities, cupboards and roof spaces, via the power wiring. The device plugs into a power point and is claimed to send a low frequency pulse through the power wiring system, of sufficient magnitude to create an intolerable environment for

unwanted nasties. All from an 'environmentally friendly' device that consumes only 7W. I guess the spiders and bugs in my fuse box must have built up an immunity to EM radiation!

I suppose many people will equate media reports of the bad effects of EM radiation as evidence that this device must work. Make it 7kW and perhaps it might, but with what side effects? Surely an example of consumerism at its worst.

## What??

Because I've included a rather difficult question elsewhere in the column, here's a relatively simple one for those without a lot of time to spend solving it. It was sent to me by Ian Davidson (Mitcham, Vic), who asks:

A drawer contains ten 5Ω resistors and ten 20Ω resistors. Without looking, how many resistors must you take from the drawer to guarantee being able to make up a 10Ω resistor?

## Answer to December's What!?

The solution to this problem lies in the fact that the triple factors of the cube root of an integer, when cubed, are the triple factors of the original integer. The cube root of 1,000,000,000 is 1000. If we can find triple factors of 1000, then these numbers when cubed will be possible dimensions of the cuboid.

Since the dimensions are to contain no zeros, but must multiply together to give 1000, only integers ending in 1, 2, 4, 5 or 8 can be considered. Possible factors are: 5 x 8 x 25; 2 x 4 x 125; 1 x 8 x 125.

When cubed, these factors become possible dimensions of the cuboid: 125 x 512 x 15,625; 8 x 64 x 1,953,125; 1 x 512 x 1,953,125. The first set of dimensions can also be rearranged to 625 x 512 x 3125.

If the surface area of a cuboid constructed to each of these sets of dimensions is calculated, it will be found that only one set has a surface area less than 800 square metres; that is 625 x 512 x 3125cm. ♦

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# AUTOMOTIVE ELECTRONICS



with JON LOUGHRON Assoc. Dip. Electronics

## Testing electronic ignition modules...

Electronic ignition modules are now commonplace in modern EFI and engine management systems. Testing the module can sometimes be difficult, but most times bench testing can save a lot of time and money. Ignition modules for automotive applications are still quite expensive, so proving their integrity may be a less painful alternative than just replacing them.

Recently I have had a few enquiries about late model ignition modules. Generally the people concerned have not necessarily wanted the intricate internal details, but more the external connections and how to test the unit for serviceability.

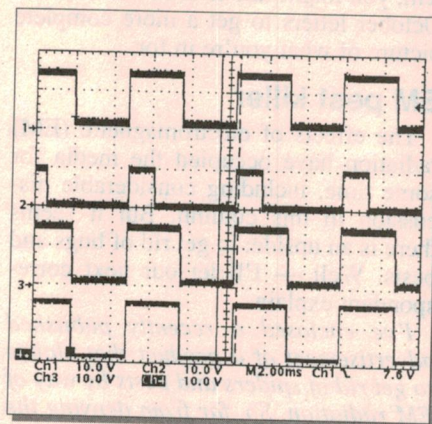
In automotive workshops these days, it is sometimes difficult to determine which component in a vehicle's ignition system is proving to be unreliable. Replacing the components one by one is not a practical or economical method of fault finding. (Although when the fault is intermittent and only happens once a week when the customer turns a left-hand corner and the ambient temperature is 22° and it never plays up for the automotive technician in the workshop, an educated guess is sometimes the only method of repairing the vehicle!)

This month I have chosen four of the more popular ignition modules, and in later months will cover more units as time and space permits. In the EST article (EA June 96) I covered the basic history of ignition systems and it could be seen that as electronics progressed, ignition systems also progressed.

As discussed in the EST article, with a points-type ignition system there was limited time and current available to 'charge' the ignition coil, so naturally the performance of the system was inhibited by this. If the current was increased too much then the life of the points was

MODULE ID	TRIGGER	DWELL CONTROL	APPLICATION
Ford TFI	ECM (Hall sensor)	Yes	Ford XF,EA,EB
Bosch '024'	Inductive	Yes	VK EFI
J117	Inductive	Yes	Mazda 323 (Laser)
J121	ECM	No	Mitsubishi Magna

**Fig. 1:** A summary showing the four electronic ignition modules discussed, how they're triggered, whether or not they have dwell control and typical applications. Most are also used in other vehicles.



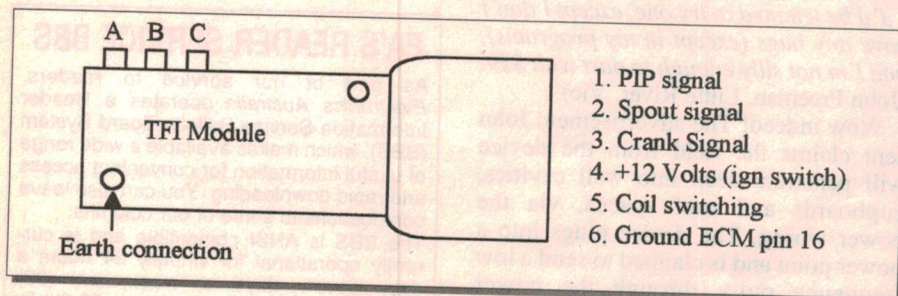
**Fig. 3:** The waveforms for the TFI module. Channel 1 (top) shows the trigger signal, channel 2 the output (negative end of the coil), channel 3 the PIP signal and channel 4 the SPOUT signal.

reduced dramatically. Different methods were employed to overcome the inherent problems of the points system and eventually electronic ignition modules became cheap enough to produce for the mass market, so points systems are now only provided on a limited number (if any) of new vehicles.

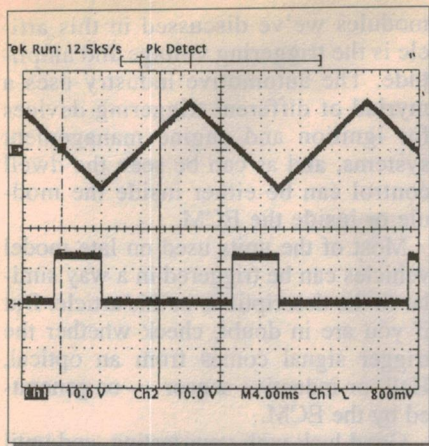
Ignition modules do basically the same as job as the points — that is, they switch the coil current on and off when required. But some have other clever internal circuitry that enables the dwell (the time that the negative side of the coil is at ground) to be controlled.

It must also be remembered that the module itself does not control the ignition timing; it only responds to the device triggering or controlling it. For example the Ford TFI module changes the ignition timing with respect to the SPOUT signal provided from the engine management ECM, whereas the Bosch '024' module is switched from an inductive trigger in the distributor — which is mounted on a swivel plate that changes its relative switching angle as engine speed increases (i.e., a centrifugal advance mechanism).

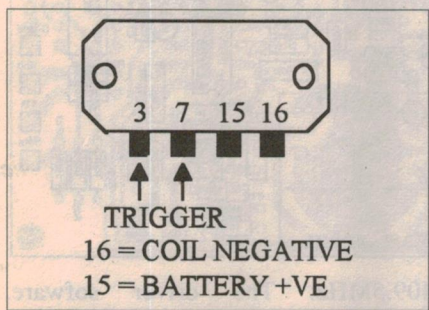
Two of the modules to be covered this month are mentioned above; the other two are the J121 power transistor used on Mitsubishi vehicles and the J117 module used on the Mazda 323 and the Ford Laser. A summary of the modules and typical applications is provided in Fig. 1.



**Fig. 2:** The connections for the TFI module. Connections A, B and C go to the Hall sensor in the distributor, while the six-pin connector goes to the ECM.



**Fig.4: The waveforms for the Bosch 024 module. At top is the triggering test signal used (here a triangular wave), while below it is the output signal (negative end of the coil).**



**Fig.5: The connections for the Bosch 024 module. Note that pin 3 is narrower, to prevent wrong connections.**

## Module testing

Well, let's get down to business. The first module on the list is the very common TFI module used on the Ford EA Falcons, etc. It is a grey module that bolts onto the side of the distributor. It has a six-pin connector that interfaces to the vehicle and a three-pin connector that connects to the Hall sensor inside the distributor (listed as A, B and C in Fig.2).

The TFI module does not have any advance control, but it does provide dwell control. The advance information is calculated in the engine management ECM and is provided from the ECM to the TFI module on the SPOUT line of the six-pin connector.

When testing the unit, only three of the six pins need to be connected and if the module is not on the distributor then A and C must be connected to a signal generator. Connect ground to pin 6, +12 volts to pin number 4 and an LED test light (pulled up to +12 volts) to pin 5.

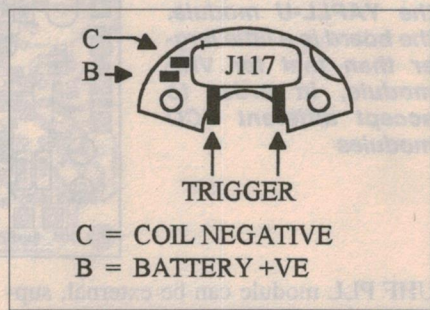
If the TFI is still on the distributor, then just turn the distributor shaft. If not,

apply +12V square wave between pins A and C (pin A ground, pin C trigger). If the unit is OK and everything is connected as above, then the LED should flash. (Remember that if you are using an LED and resistor the LED orientation must be correct — anode to +12V!)

While I was doing some work on the bench recently I happened to notice that if you connect the TFI as above, you can also see a square wave on the PIP and SPOUT connections. Fig.3 is a printout from one of the wonderful Tektronix four-channel scopes: channel 1 is the trigger in, channel 2 is the output to the coil, channel 3 is the PIP signal and channel 4 is the SPOUT signal.

## The Bosch 024

Next on the agenda is the Bosch 024 module. On the VK Commodore it is mounted on a base plate (heatsink) on the



**Fig.6: The connections for the J117 module. The trigger signal connects to the two centre pins.**

outside of the distributor, under a metal shield. It is a four-pin module that is triggered by an inductive pulse generator inside the distributor (the pulse generator resistance is approximately 1000 ohms). The pulse generator emits an AC signal and this signal is applied to pins 3 and 7.

You will notice that on the module pin 3 is smaller than pin 7. This is done to avoid incorrect connection of the trigger and thus causing advance problems.

When bench testing, the module orientation of these pins is not a problem because we are checking for a go/no-go situation. Connect an AC signal generator to pins 3 and 7 and as can be seen from the patterns in Fig.4, almost any AC waveform can trigger the module (although 240 volts AC is definitely not recommended).

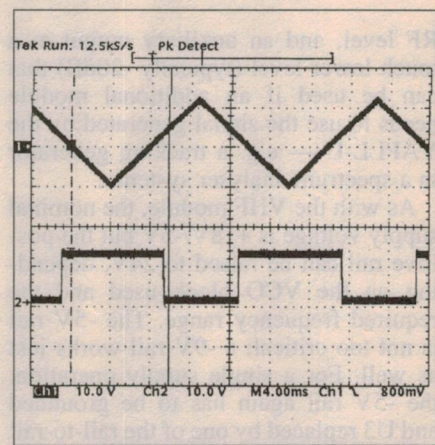
The coil connects to pin 16 and when testing the unit, again we can check for switching with an LED test light. Connect +12V to pin 15, while ground is connected to the base (metal bit) of the unit. Fig.4 is the waveform for the 024 module and Fig.5 shows the module and its connections.

## The J117 module

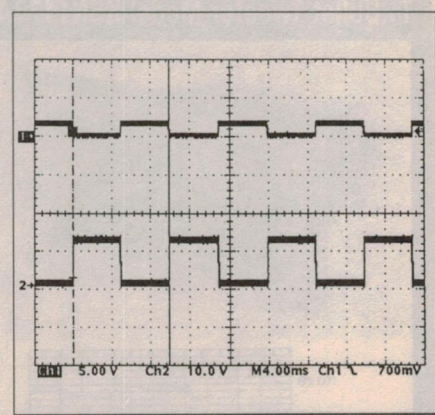
The J117 module (Fig.6) is also triggered with an AC waveform. This ignition module is mounted inside the distributor and it couples directly to the inductive pulse generator.

When bench testing the J117 module, connect an AC trigger to the middle pins as shown in Fig.6. Terminal B is connected to +12V, terminal C to the negative side of the coil and the metal base to earth (very similar to the 024 module).

If you look at the patterns in Fig.7 and compare them with those in Fig.4, you will notice that the trigger waveforms are identical (triangular AC waves), but the output from the modules (dwell time) is quite different. This is one reason, apart from physical differences, why the 024 and J117 modules cannot be interchanged.



**Fig.7: The waveforms for the J117 module. Although the same trigger signal was used for the 024 module (Fig.4), note that the output signal is quite different.**



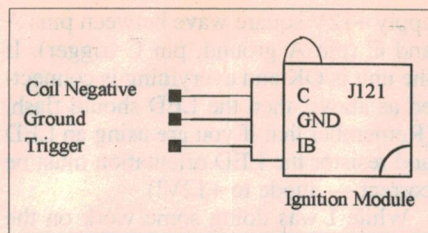
**Fig.8: The waveforms for the J121 module. As this is basically just a power transistor, the output (lower trace) is an inverted version of the trigger signal.**

## AUTO ELECTRONICS

### The J121 module

The last ignition module to be discussed is the J121. This module is actually a power transistor, and as can be seen from the patterns in Fig.8 the output to the coil is the inverse of the input on the base. The connections for the J121 module are shown in Fig.9.

Testing the J121 unit is quite simple. Connect the coil (or test lamp) to the C terminal, connect a TTL square wave trigger signal to the base (IB), ground the middle terminal (G). The module provides no dwell control and



**Fig.9: The connections for the J121 module. There are only three, as you can see.**

is really only a switch; the dwell and timing control is done with a 'map' (lookup table) inside the ECM.

The main differences between the

modules we've discussed in this article is the triggering voltage and amplitude. The automotive industry uses a myriad of different triggering devices for ignition and engine management systems, and as can be seen the dwell control can be either inside the module or inside the ECM.

Most of the units used on late model vehicles can be triggered in a way similar to the descriptions in this article. But if you are in doubt, check whether the trigger signal comes from an optical, Hall, or inductive sensor — or generated by the ECM.

Good luck with your testing, and until next time — bye. ♦

## PLL Modules

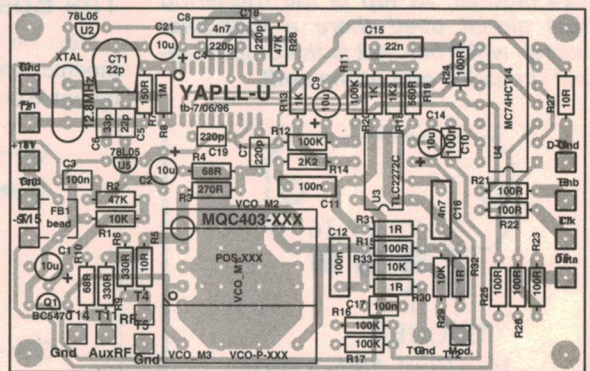
*continued from page 85*

RF level, and an auxiliary output at a much lower level (typically -20dB) that can be used if an additional module needs to use the signal generated by the YAPLL-U — e.g. a tracking generator in a spectrum analyser system...

As with the VHF module, the nominal supply voltage is +18V/-5V but the positive rail can be raised to 24V, depending on the VCO block used and the required frequency range. The -5V rail is not too critical; a -9V rail works just as well. For a single supply operation, the -5V rail again has to be grounded and U3 replaced by one of the rail-to-rail output CMOS input op-amps. Again, watch out for the maximum allowable supply voltage of these ICs.

Again the frequency reference for the

**Fig.5: The overlay for the YAPLL-U module. the board is a little larger than that for VHF module, in order to accept different VCO modules**



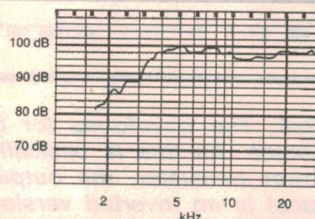
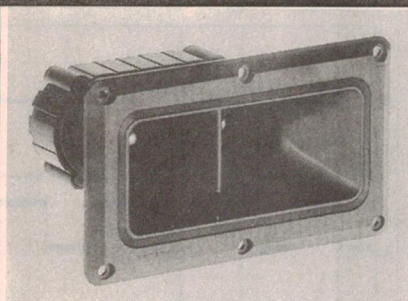
UHF PLL module can be external, supplied by a YADDS-1 module, or an internal, using the on-board crystal oscillator. The range of possible PLL reference frequencies is limited by the dual-modulus nature of the divider in the main PLL IC. The smallest valid 'N' that can be programmed to the IC is 4095, thus for a 100kHz reference frequency the lowest output frequency is

409.5MHz. The driver software, 'YAPLLU.EXE' is preconfigured for a DDS-driven PLL setup, using a 100kHz reference frequency.

In the second of these articles, I'll explain how the modules are assembled and programmed, and also how to select and adjust the loop filter characteristics for different applications.

(To be continued.) ♦

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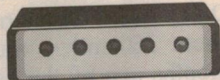
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# 50 and 25 years ago...

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## January 1947

**Microwave Television Pickup:** Television pickup relay apparatus capable of relaying signals from the pickup point to a television transmitter within a 15-mile range has been announced by the Radio Corporation of America.

This new radio relay equipment produces a frequency-modulated signal with approximately 100 milliwatts of power for the picture carrier. The bandwidth permits reproduction of the finest details in the camera picture. It operates at any selected frequency in the 6500 to 7050-megacycle band.

The use of a highly directional parabolic transmitting antenna provides a signal gain of about 5000 times, with a 4-foot reflector, or 11,500 times with a 6-foot reflector, thereby providing an

equivalent power of 500 or 1150 watts, depending upon reflector size, in the direction of the receiving antenna.

**UHF Records Broken:** A few weeks ago, 6-metre signals from an amateur station located in Victoria were received for a short period in Sydney and Wyong, at excellent strength. This is the first time that signals on these frequencies have been heard in Australia over such large distances.

## January 1972

**Public Videotelephone on Trial:** Is the videotelephone just around the corner? Many stories in the daily press would have us believe so, but engineers who appreciate the problems consider that such a service is many years away.

The first public video telephone con-

versation between Munich and Darmstadt, West Germany, a distance of about 250 miles, was conducted some months ago by the head of the German Post Office, Mr George Leber, and Mr Dieter von Sanden, a director of Siemens. This trial operation between the German Post Office and the Telecommunications Centre of Siemens AG is a continuation of a development which began as long ago as 1936, with the world's first public video telephone connection between Berlin and Leipzig.

**Isoplanar — New Process for ICs:** A new process for manufacturing bipolar integrated circuits, called Isoplanar, has been developed by Fairchild in the USA. The new process provides the ability to design integrated circuits combining the complexity of metal-oxide-silicon (MOS) devices with the performance of transistor-transistor logic (TTL) and emitter-coupled logic (ECL) devices.

Component densities comparable with MOS are possible, with higher yields than conventional bipolar devices. Other advantages claimed are high reliability, retention of the bipolar features of high speed, single power supplies, and direct logic compatibility with TTL and ECL.

Isoplanar is essentially an evolution of the Fairchild Planar process. ♦

## EA CROSSWORD

### ACROSS

- 1 Warming network. (8,7)
- 8 Substitute. (7)
- 10 Assigned frequency. (7)
- 11 Satellite. (4)
- 12 Item of information. (5)
- 13 Flat instrument. (4)
- 16 Type of insulator. (7)
- 18 Method of distance measurement preceding laser use. (6)
- 20 Publishing runs. (6)
- 22 Not optimised to correct

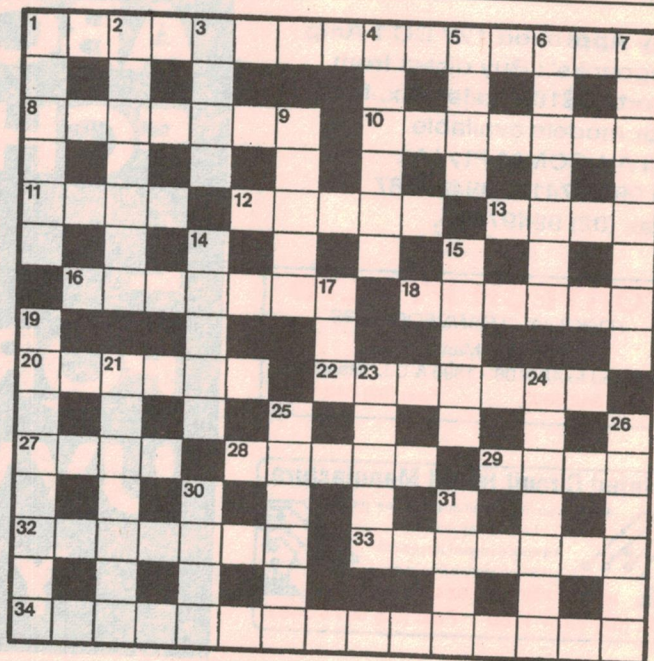
### SOLUTION TO DECEMBER 1996:

KLYSTRON WOOFER  
I N C P O A  
L I C E N C E E N T E R E D  
O A T W L O T O  
V L B I F A L S E D R A M  
O L C Y I S A E  
L I E L O W B U T T O N S  
T B E S R A  
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L I T A A B K M  
I N S T A N T C O U L O M B  
U T P E L R L  
M O S F E T K E N N E L L Y

- settings. (7)
- 27 Eliminate unwanted recording. (4)
- 28 Safety devices. (5)
- 29 Item used in animal identification. (4)
- 32 Solar clock. (7)
- 33 Waterproof. (7)
- 34 Flow of charge. (8,7)

### DOWN

- 1 Erasable programmable read-only memories. (6)
- 2 Investigate the unknown. (7)
- 3 Electric traction vehicle. (4)
- 4 Reserve copy of information. (4-2)
- 5 Apple's first accessory? (4)
- 6 Brand of hifi equipment. (7)
- 7 Outmoded communication. (8)
- 9 Tunnel diode. (5)
- 14 Stored data in memory. (5)
- 15 Strengthening brace. (5)
- 17 Central processing unit. (1,1,1)



- 19 One given a permit. (8)
- 21 Organised system of study. (7)
- 23 Given name of physicist Bohr. (5)
- 24 Improve quality of... (7)
- 25 Dense parts of atoms. (6)
- 26 Consequence of countdown? (6)
- 30 Aerodynamic force. (4)
- 31 Group of two. (4) ♦

Electronics Australia's

# Professional Electronics

S ♦ U ♦ P ♦ P ♦ L ♦ E ♦ M ♦ E ♦ N ♦ T

**FIRST DIGITAL TELEVISION  
BROADCAST IN AUSTRALIA**

**ITU APPROVES FASTER V.34  
MODEM STANDARD: 33.6kb/s**

**HP, PHILIPS, RICOH, SONY &  
VERBATIM COMMIT TO  
RE-WRITABLE CD TECHNOLOGY**

**SAMSUNG DEVELOPS DRAM  
WITH 1-GIGABIT CAPACITY**



**IOMEGA'S ZIP 100 DRIVE AND ITS REMOVEABLE 100MB  
DISKS: COMPACT, CONVENIENT & PORTABLE STORAGE  
FOR TODAY'S LARGE FILES...**

*(See review inside)*

# NEWS HIGHLIGHTS

## OPTUS HANDS OVER DEFENCE NETWORK

Optus Communications has handed over the \$13.5 million interim Defence Mobile Communications Network (DMCN) to the Commonwealth Department of Defence.

The interim DMCN is based around the Optus MobileSat system, claimed as the world's first mobile satellite car phone. MobileSat offers mobile voice, data and fax services via the L-band transponders on Optus' B-series satellites, to and from anywhere in Australia and up to 200km out to sea.

The interim DMCN is expected to provide a platform which Defence can use to evaluate its satellite-based mobile options, as it moves towards a mature system.

Around 16 months ago, the Department of Defence awarded Optus Communications two contracts for its mobile communications, worth more than \$14 million over three years. The interim DMCN brought together the original MobileSat development team of Optus, NEC and CSC Australia to develop a unique solution for Defence.



*A technician at Germany's leading optics and precision engineering firm Carl Zeiss Jena GmbH checks out a space research telescope. Last year the firm celebrated 150 years of operation. (Inter Naciones/Zeiss)*

## COCHLEAR'S 'SPRINT' WINS IE AUST AWARDS

At a recent Gala Dinner held by the Sydney Division of the Institution of Engineers at the Sydney Town Hall, Cochlear Limited won two Engineering Excellence awards for its Sprint Cochlear Implant System. The system won both the Innovation and Engineering Products and Manufacturing awards.

Other firms presented with awards included ADI Limited for its ADI Minesweeping and Support System (AMASS) and Kirby Engineering for its CNC Slot Machining System.

## DOMINION WINS DISTRIBUTOR AWARD

Californian firm Z-World Engineering, manufacturer of Dynamic C and other microprocessor-based products, has awarded its 1996 Outstanding Distributor Award to Australian distributor Dominion Electronics. Dominion's sales of Dynamic C and other systems were ahead of distributors in Italy, the Netherlands, Korea, Singapore and Canada.

The award was presented by Z-World's distributor representative Wil Florentino, and was accepted by Dominion's Andrew McLeod. Dominion has been selling Z-World's products for more than three years, and became the official distributor in April 1995. Prominent clients in Australia include the CSIRO, Telstra, Ford Australia, Alcatel Tasman and Pacific Power.

## PHILIPS COMMITS TO CD-RW TECHNOLOGY

At the recent official launch of CD-ReWritable (CD-RW) technology in San Francisco, Philips Electronics committed itself to volume shipments of its first CD-RW drives in the first half of 1997.

CD-RW drives allow users to read CD-ROM discs, read and write CD-R discs and read, write and rewrite CD-RW media.

"Where CD-Recordable revolutionised the Compact Disc market by making it possible to make your own CDs, CD-ReWritable lets you create a disc and then change it as the contents need to be updated", said Jan Oosterveld,

President and CEO of Philips Key Modules, the business group responsible for CD and DVD technology strategies at Philips Electronics. "It is the logical next step in Compact Disc products for computer applications."

CD-RW technology was launched by five of the industry's leading firms: Hewlett-Packard, Mitsubishi Chemical Corp (Verbatim), Philips Electronics, Ricoh and Sony Corporation. Details about product features and specifications are expected to be announced soon. The initial list price for a drive complete with adapter card and software is targeted at levels below US\$1000. The drives will be manufactured at Philips plants in Belgium and Hungary, and made available under various brand names.

## ITU APPROVES FASTER V.34 MODEMS

The International Telecommunication Union has approved an amendment to the V.34 modem standard which will allow modems to send and receive data at rates of up to 33,600 bits per second.

Developed by Study Group 14 of the ITU's Telecommunication Standardization Sector, the amended standard was accepted at the World Telecommunication Standardization Conference held in Geneva. The WTSC is convened every four years to review and streamline the structure and working methods of the global standardization process.

The acceptance of the amended V.34 standard has given the go-ahead for equipment manufacturers to start to deliver new products based on this high performance data technology. Increased modem transmission speed cuts down the time needed by computers and fax machines to transfer information, resulting in lower telephone bills.

Like the earlier version of V.34, the new modem will feature the ability to automatically adjust its speed based on the quality of the telephone line. Known as 'line probing', this feature allows the modem to choose the highest possible transmission rate while at the same time minimizing the likelihood of data errors. The modem also supports a half duplex mode of operation for fax, and supports automodem to existing V-series modems.

Other important features of the new technology which will be retained in the new version of the standard include an optional auxiliary channel, trellis coding and a 'handshaking' capability. The auxiliary channel has a synchronous data signalling rate of 200b/s, and is primarily intended to be used to convey modem control data independent of the primary channel, which operates at between 2400 and 33,600b/s. Multi-dimensional trellis coding is used to improve throughput by providing higher immunity to noise and other phone line impairments. Included in the 'handshake' is a capability which allows modems to identify themselves to other modems, which leads to shorter times to connect.

## TRUNKED RADIO FOR NORFOLK ISLAND

Norfolk Island Telecom has installed a trunked radio system that has enhanced emergency communications across the Island.

Supplied by Tait Electronics, one of the largest manufacturers of network radio, the system allows customers to use their radios like telephone handsets to receive and make local and international calls. It uses a single site and was installed in response to Norfolk Island's need for communications for emergency services and public utilities, and also allows Norfolk Island Telecom a service to sell to the public as a substitute for cellular phones.

The Tait trunked radio system was chosen because it provides large area coverage across the island and up to 40km out to sea. This is particularly important in times of emergency, as Norfolk Island residents can now contact any emergency service from anywhere on the Island or out at sea.

Tait Electronics is headquartered in New Zealand and has five Australian offices.

## PHILIPS TO DEVELOP NEW TRAFFIC SYSTEM

Philips Electronics Australia is to play a key role in the development of SCATS 2, an enhanced Australian designed intelligent traffic management system which is expected to earn significant export orders, following a NSW Roads and Traffic Authority decision to invest in a multi-million dollar upgrade.

Philips Traffic & Engineering Systems at Moorebank in Sydney is the company's international centre of expertise for intelligent road traffic management systems and is the largest manufacturer of traffic



*The world's growing emphasis on high-tech sporting facilities has also generated business for some electrical and electronics industries. Germany's lighting specialist Osram recently won a big order to supply halogen lighting for Japan's biggest and most modern indoor swimming centre.*

control hardware for the SCATS system. New investment will be undertaken at Moorebank to manufacture state of the art controllers to operate with SCATS 2.

The computer-based monitoring, management and communications system known as SCATS (Sydney Co-ordinated Adaptive Traffic System) was originally developed by the RTA in 1974 and is currently helping to smooth traffic flow in 40 cities in Australia, the United States, Malaysia, Hong Kong, Ireland, China, New Zealand and Singapore. All these cities will be able to take advantage of the benefits of SCATS 2.

SCATS has been marketed around the world through an exclusive distribution arrangement with Philips Electronics Australia and AWA. Philips is actively promoting SCATS on six continents.

The RTA decision to proceed with SCATS 2 reinforces Australia's pre-eminent international position as a high technology and service provider in the intelligent transport systems now regarded as crucial elements in support of urban and inter-urban infrastructure.

Philips Electronics Chairman and CEO Justus Veeneklaas predicts SCATS 2 will be a significant export dollar earner for Australia. "In the lead-up to the Olympics we have a wonderful marketing opportunity to showcase SCATS 2 capabilities to the world," he said. "In Barcelona and Atlanta the Olympics created major traffic headaches. By contrast the smooth efficiency we expect SCATS

2 to generate in Sydney 2000 will be strikingly obvious for Games visitors and city residents alike."

## S-A GETS EMMY FOR ITS VIDEO COMPRESSION

The board of governors of The Academy of Television Arts and Sciences has honoured Scientific-Atlanta, Inc. with an Emmy, in recognition of the company's 'pioneering work in the development and implementation of digital compression systems'. The award was presented on November 19, 1996, at The Academy's Engineering Awards Luncheon.

Dwight Duke, president of S-A's satellite television network division said "We are especially pleased and honoured by the fact that this award is based on the engineering committee's recognition of our contribution to digital video compression. This gives special significance to the award, since it is founded on the committee's knowledge of not only the well-publicised technical and engineering aspects of this industry, but also on their unique insight into our behind-the-scenes labours and efforts that made digital video compression's potential become a reality."

Active in developing and providing MPEG-based digital video compression systems for much of this decade, Scientific-Atlanta played a major role in developing the MPEG-2 standard. The company's commitment to MPEG-2 and DVB in its PowerVu products has made

them a popular choice for programmers and broadcasters including Turner Broadcasting Systems, Discovery Channel and The Family Channel in the USA. In Australia, Network Ten, The Australian Broadcasting Corporation and MEDIASAT use PowerVu compression for contribution feeds and expanded news broadcasting.

### FIRST DIGITAL TV BROADCAST IN AUST

Australia's first digital television transmission was initiated by the Minister for Communications and the Arts, Senator Richard Alston, at a special dinner for Australian television station executives on Saturday night, 16 November. The test transmission was the feature of a dinner to end the 1996 Federation of Australian Commercial Television Stations (FACTS) annual engineering seminar.

While digital television is still some years away from reality in Australia, the test transmission gave an opportunity for the industry to better understand the technology and the opportunity it presents.

A Harris Platinum EL series transmitter supplied by Comsys was used for the transmission. The same transmitter is also being used in field trials on Digital Terrestrial Television Broadcasting (DTTB), which have followed the test/demonstration.

DTTB will enable the current network broadcasters to compete with multiple-channel Pay TV operators by enabling them to offer a combination of high definition television and multiple channels.

### TOSHIBA 2.5" HDD HAS 3.3GB CAPACITY

Toshiba Corporation in Japan has developed two compact 2.5" hard disk drives which achieve what is claimed to be the industry's largest storage capacities for their form factors.

With a height of 19mm, the MK3303MAN's 3.3-gigabyte storage capacity makes it the industry's largest-capacity drive in its class. The slim-type 12.7mm MK2103MAV has a storage capacity of 2.16GB, a larger capacity than any other drive of the same height on the market.

The MK3303MAN drive has a weight of 220g, a disk rotation speed of 4852rpm, a data transfer rate of 16.6MB/s and a large-capacity 128KB buffer memory, offering high-speed



*Hewlett-Packard's Australian Telecommunications operation in Melbourne received a 'Highly Commended' award in the AEEMA's 1996 Exporter of the Year Awards. In its last fiscal year ending October 1995, H-P Australia's export sales totalled \$113 million.*

access at an average seek time of 13ms. It also meets ATA-3, the global standard for connecting PCs and HDD.

The MK2103MAV has a weight of just 155g, a disk rotation speed of 4200rpm. It too offers a data transfer rate of 16.6MB/s and a large-capacity 128KB buffer memory, and an average seek time of 13ms.

### TELSTRA TO USE MOTOROLA CABLE MODEMS

Motorola Inc's Multimedia Group has been selected by Australian telecommunications operator Telstra Corporation to provide cable modems for Telstra's rollout of high-speed online access over its broadband network. The launch is claimed to represent the first commercial deployment of high-speed data services in the Asia-Pacific region.

Telstra, Australia's largest telecommunications company, has agreed in principle to an initial order of Motorola CyberSURFR cable modems as the first step in a wider deployment, as the company establishes high-speed online services for customers in Sydney and Melbourne.

"Telstra is proud to be the first telecommunications company to offer commercial high-speed data services to

Australians", said Gerry Moriarty, chief executive officer of Telstra Multimedia. "By using the high capacity hybrid fibre-coax (HFC) infrastructure, Telstra will be able to deliver much richer content — including interactive multimedia services, World Wide Web access and video streaming — than would be possible using existing telephone lines."

Because coaxial cable has more capacity for data than the traditional telephone lines most frequently used for Internet access, consumers can gather information from the Internet at speeds many times faster than presently possible. The CyberSURFR cable modem offers users speeds of up to 30Mb/s in the downstream path and up to 768kb/s in the upstream path (where interactive commands, requests, etc. are routed from the user back to the Internet provider).

### MARCONI SCHOOL RE-UNION PLANNED

A re-union in Sydney of ex Marconi School of Wireless students is planned for later this year.

The school closed in 1981 and with it into retirement went Ces Bardwell, who joined the School as an instructor in 1939.

Re-union organised David Hawksworth believes Mr Bardwell became principal/manager in 1949 and held that position until the School closed.

Ces will be 80 this year and will be guest of honour at the planned reunion. Mr Hawksworth is trying to contact all former Marconi students, to give them an opportunity to attend the function.

Information required from those interested in attending the re-union should include the year/years of attendance and whether full time or part time. Mr Hawksworth can be contacted by writing to him at 84 Duncan Street, Vincentia 2540; or by fax to (044) 210032 marked 'Attention David Hawksworth'; or by email to [techfm@peg.apc.org](mailto:techfm@peg.apc.org).

## X-RAY TELESCOPE MIRROR COMPLETED

The world's most powerful X-ray observatory came a major step closer to completion recently with the assembly of its high resolution mirrors. The last of four pairs of unique mirrors which form the heart of NASA's Advanced X-ray Astrophysics Facility (AXAF) were aligned and cemented into place at Eastman Kodak's Federal Systems Division in Rochester, New York.

"The extreme sensitivity of the mirrors made the installation a very delicate process," said John Humphreys, Project Development Manager at NASA's Marshall Space Flight Center, Huntsville, AL. "Successful completion of the process represents a real achievement in the development of the telescope."

Unlike the concave, nearly flat mirrors used in optical telescopes, the AXAF mirrors are shallow, almost cylindrical cones. The four pairs of mirrors are nested inside each other. X-rays enter the telescope, graze off the mirrors — much like a stone skipping across the surface of a pond — and are focused onto a plane 30 feet

behind the front of the mirrors.

The largest of the mirrors is 47.2 inches, which makes this mirror set the largest ever made. The size and accuracy of the mirrors will make AXAF 100 times more sensitive than previous X-ray telescopes, producing images 10 times sharper.

The observatory is scheduled for a Space Shuttle launch in 1998. In orbit, it will obtain never-before-seen images of highly energized X-ray sources — such as neutron stars, black holes, debris from exploding stars, quasars, centres of galaxies and galaxy clusters.

AXAF is expected to rank among NASA's great observatories, along with the Hubble Telescope and the Compton Gamma Ray Observatory. It will explore some of the most intriguing mysteries in space and offer a better understanding and knowledge of the universe.

## SMALL BUSINESS TASK FORCE REPORTS

The Small Business Deregulation Task Force presented its report *Time for Business* to the Prime Minister, the Hon John Howard MP, in Sydney on November 1. The report contains 62 recommendations that address a wide range of paperwork and compliance issues faced by small business.

The Task Force found that taxation requirements, employment-related regulation and the lack of coordination between government agencies were major causes of the burden on small business. It called for a change in the way governments interact with the small business. The recommendations likely to benefit small business most include:

- simplifying the fringe benefits tax regime;
- developing a single annual compliance statement for taxation obligations;
- reviewing the Income Tax and Wholesale Sales Tax Acts to address

- compliance difficulties and anomalies;
- creating nationally consistent OH&S and workers compensation regulations;
- exempting casual employees from the superannuation guarantee charge;
- creating a comprehensive business information service;
- reducing the number of forms small business must deal with;
- developing a single business identification number and single entry point into government;
- establishing service charters for government agencies;
- improving regulation scrutiny, review and reporting processes; and
- establishing effective consultation and accountability mechanisms.

Copies of the Task Force's key findings and recommendations are available on the Internet at <http://www.dist.gov.au/smallbus/sbtf.html>, or may be purchased through the AGPS bookshop in each capital city.

## CONTINUE COMPUTER BOUNTY, SAYS ATIA

"Continuation of the computer bounty beyond July 1997 is crucial to continuing investment in the Australian electronics industry and improvements in competitiveness, particularly amongst SMEs", commented ATIA Executive Director Alex Gosman following the association's submission to the Senate Economics Committee inquiry into the Computer Bounty. "The Budget decision to abolish the bounty was taken without any due consultation or consideration of the impact upon industry, and came just eight months after the Coalition agreed to its extension to the Year 2000."

The Computer Bounty has assisted industry across such areas as electronic components, PCB, electronic assembly, data communications and electronic controls, in attaining improved levels of international competitiveness through supporting increased levels of investment, R&D and exports.

"Members had factored the continuation of the bounty into forward investment plans, and the decision to abolish the bounty from 1 July 1997 has caused considerable business uncertainty, particularly when combined with such decisions as changes to the Tariff Concession Scheme, which have significantly increased costs."

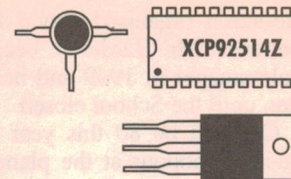
The ATIA believes a number of its members will close down their operations without the bounty, particularly in the current economic climate. Up to 1600 jobs could be lost. ♦

## NEWS BRIEFS

- **Independent Distribution Network (IDN)** has been appointed as the Australian agent for F.W. Bell Inc, a US manufacturer of measurement and test instrumentation.
- Joe Oliva has been appointed General Manager Australia for **Wandel and Golterman**.
- **Veltek Australia** has announced it is on the Web, at <http://www.veltek.com.au>. The site provides data and application notes for the company's semiconductors and other products.
- Australia's second **International Advanced Technology Boat Race** will be held on Lake Burley Griffin, Canberra, Saturday 12 April 1997.
- **Jands Electronics** has moved from its St Peters factory to Mascot. Contact details are: 40 Kent Road (Locked Bag 15), Mascot 2020; phone (02) 9582 0909, fax (02) 9582 0999.
- A conference titled **Evaluating the role of ATM in Network Infrastructures** will be held 19 and 20 February, 1997 at the Wentworth Hotel, Sydney. For more information phone (02) 9929 5366.
- Yokogawa Australia has appointed **Rapid-Tech Equipment** as the exclusive representative in Victoria and Tasmania for the company's range of test and measurement instruments.
- **Siemens** has announced it is now marketing a range of Vacuumschmelze GmbH (VAC) products in Australia and New Zealand. ♦

# Solid State Update

KEEPING YOU INFORMED ON THE LATEST DEVELOPMENTS IN SEMICONDUCTOR TECHNOLOGY



## Switcher IC is 96.5% efficient

National Semiconductor has released a monolithic synchronous step-down switching regulator that features a 96.5% peak efficiency. Designed for portable systems, the LM2650 integrates a controller and a MOSFET on a single chip, and has a 3A load range. The new device was developed using National's LMDMOS 300B process technology, and its design eliminates the need for a current sense resistor, a Schottky diode and several low-ESR



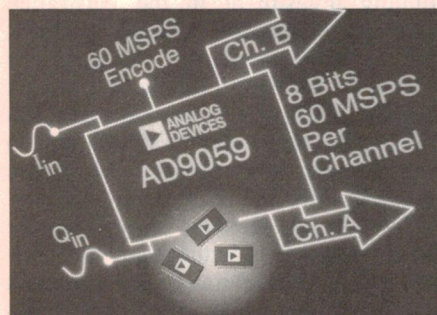
(equivalent series resistance) capacitors. The regulator accepts an input from 4V to 18V, and has an adjustable output voltage of 1.23V to 16V. Its peak efficiency is

96.5%, and is typically better than 90% over a 15mA to 3A load range. The device also features an automatic sleep mode, and on-chip protection features include thermal shutdown, current limiting and programmable soft start. Applications include battery-powered instruments, portable data terminals and high-efficiency network appliances. The device comes in an S0-24 package.

For further information circle 277 on the reader service coupon or contact National Semiconductor, Business Park Drive, Monash Business Park, Notting Hill 3168; phone (03) 9558 9999.

## Single/dual 8-bit, 60MS/s ADCs

Analog Devices has introduced two 8-bit, 60MS/s analog-to-digital converters (ADCs), claimed to offer excellent per-



formance for applications requiring a high conversion rate, wide analog bandwidth and low power dissipation. The AD9057 (single channel) and the AD9059 (dual channel) monolithic converters have an analog bandwidth of 120MHz for high-speed applications such as digital communications, video processing, digital data storage, medical imaging and digital instrumentation.

The devices combine single stage Gray code conversion and flash converter architectures, claimed to produce speed, power and performance levels previously unavailable with standard bipolar flash or CMOS converter architectures. Operating from a single +5V supply, the converters include an internal +2.5V reference and

track-and-hold circuit, and interface directly to +5V or +3V logic systems. The AD9057 takes 250mW (typical) at full operation and less than 10mW in power-down mode. The AD9059 is specified at 400mW (typical) under full operation and less than 12mW in power-down mode.

Both parts are fabricated on an advanced BiCMOS process and are specified over a -40 to +85°C temperature range. The AD9057 is housed in a 20-lead surface mount plastic package (SSOP), and the AD9059 is available in a 28-pin SSOP.

For further information circle 275 on the reader service coupon or contact Analog Devices, PO Box 98, West Rosebud 3940; phone (059) 86 7755.

## 15GHz PLL synthesiser

Miteq's new SLS series of synthesisers use a fast tuning phase-locked loop architecture, claimed to provide a balanced combination of exceptionally low

phase noise and tuning speed. They are suited for wireless and SATCOM applications over the frequency range of 1-15GHz, with a tuning bandwidth of up to half an octave and step sizes down to 200kHz. The devices are ruggedised

against shock and vibration.

For further information circle 271 on the reader service coupon or contact Electronic Development Sales, Unit 2A, 11-13 Orion Road, Lane Cove 2066; phone (02) 9418 6999.

## 4MHz op-amp is grain sized

National Semiconductor has introduced the LM7301, a single supply op-amp in a grain-sized SOT 23-5 TinyPak package, for space constrained applications. The device features a rail-to-rail I/O operating voltage range from 1.8V to 32V, a 4MHz gain bandwidth, low distortion and high output drive current (9.8mA at 5V). It is suited for a broad range of both low power and industrial applications.

The LM7301 has a THD of 0.006%,



takes a supply current of 0.72mA and operates from a supply voltage ranging from 1.8V to 32V. It can handle volt-

ages in excess of both power supply rails and has a capacitive load drive of 1nF. The device has a PSRR (power supply rejection ratio) of 104dB, a CMRR (common mode rejection ratio) of 93dB and a gain of 97dB. The device operates over the industrial temperature range of -40 to +85°C. It is available in a plastic five-lead SOT-23 TinyPak or eight-lead SOT-8 package.

For further information circle 273 on the reader service coupon or contact National Semiconductor, Business Park Drive, Monash Business Park, Notting Hill 3168; phone (03) 9558 9999.

## Low power, UHF PLLs

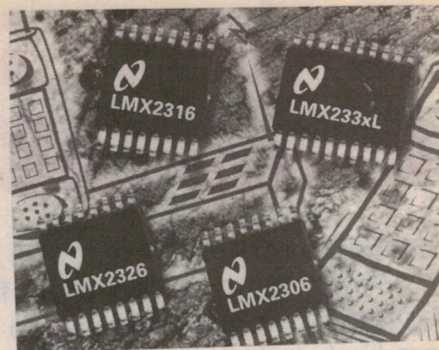
National Semiconductor has announced the addition of eight new low power single and dual phase-locked loops (PLLs) to its PLLatinum family of frequency synthesizers. The new devices include three low power single PLLs (LMX2306, LMX2316, LMX2326) and five low power dual PLLs (LMX2330L, LMX2331L, LMX2332L, LMX2335L, LMX2336L), claimed to constitute the next generation of high performance ICs for the wireless and mobile RF market.

To maintain high performance specifications while lowering the power consumption of the new PLLs, National has optimised its BiCMOS process, implemented a new patented three-sided emitter RF transistor architecture, and used an improved signal isolation technique.

The LMX2306 has a frequency range

of 0.5GHz and a current consumption of 1.2mA, the LMX2316 is specified at 1.2GHz/2mA, and the LMX2326 at 3GHz/3.5mA. The devices feature an enhanced architecture that includes a digital lock detect, a 16-pin TSSOP package, and an enhanced FastLock feature with hardware timer support. Compatible with the JEDEC 2.5V Vcc standard, they have an operating voltage range of 2.3 to 5.5V and a phase noise floor of -167dBc/Hz.

The dual PLL devices operate within a 2.7 to 5.5V voltage range, up to a frequency of 2.5GHz. The LMX233xL family has the same pinout and programming models as National's LMX233xA family. The phase noise floor is -169dBc/Hz, with a 60% reduction in power consumption compared to the LMX233xA family. The LMX233xL are additions to the family, not replacements for current products.



Applications include cordless/cellular telephones, wireless LANs, direct broadcast satellite and global positioning systems.

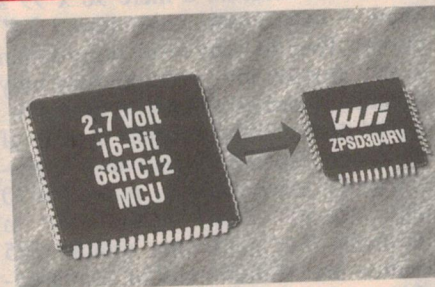
For further information circle 279 on the reader service coupon or contact National Semiconductor, Business Park Drive, Monash Business Park, Notting Hill 3168; phone (03) 9558 9999.

## Low power 2.7V micro has 256KB of EPROM

US-based WSI has announced its new 2.7V, 16-bit programmable microcontroller peripheral IC, the ZPSD304RV. The controller consumes 1uA in standby mode and 0.9mA/MHz when operating, and is aimed at systems operating from batteries, super caps, telephone lines or PC serial ports.

The ZPSD304RV integrates 256KB (2Mb) of EPROM, extra I/O and programmable logic. When operating at 1MHz, the IC takes 1.2mA, claimed to be around one sixth the power required by an equivalent discrete circuit.

The device features a small footprint and integrates a programmable address



decoder, memory mapping that allows program code to be placed anywhere in the memory address space, I/O port reconstruction, security features, 19 individually configurable I/O port pins, and a programmable interface to any 16-bit MCU from Philips, Motorola, Intel or others.

The very low power consumption of the IC is achieved by using address transition detection circuitry to maintain the device in an internal power-off mode until an address input transition occurs. As a result, every part of the chip is always powered down unless it is being used. Additional power savings are obtained from a differential method of signal sensing.

The controller also has a security bit that can be set to make the device configuration invisible, thereby making it extremely difficult to reverse engineer or duplicate the program code.

For further information circle 272 on the reader service coupon or contact Zatek, PO Box 228, Burwood 2134; phone (02) 9744 5711.

## 12-bit ADC takes 1mW

The new ADS1286 from Burr-Brown is a 12-bit, 20kHz micropower sampling ADC with a differential input and sample/hold amplifier. The device takes a supply current of 250uA, its power consumption is 1mW and the IC is available in a compact eight-lead SOIC. It has an SPI

and SSI compatible serial interface for communication over a two- or three-wire interface, making it suited for remote and isolated data acquisition, transducer interfacing, and for battery operated systems. Other applications include industrial process control, test and measurement, medical instrumentation, and consumer products.

The device topology eliminates internal resistors, and features instead a switched capacitor technique. It is claimed as the smallest 12-bit sampling ADC on the market. Specifications and features include: true differential inputs, serial interface, guaranteed no missing codes and a 20kHz sampling rate. It is available in an 8-pin plastic mini DIP and an 8-lead SOIC package.

For further information circle 276 on the reader service coupon or contact Kenelec, 2 Apollo Court, Blackburn 3130; phone (03) 9878 2700. ♦

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# IOMEGA'S 'ZIP 100' REMOVABLE 100MB DRIVE

Iomega's Zip 100 drive and its low cost, removable 100MB disks have rapidly become one of the most popular media overseas for archiving and transporting relatively large computer files. Some have even suggested that Zip disks, which are only slightly larger than traditional 3.5" floppies, are likely to become their successor. Here's a hands-on report.

by JIM ROWE

With more and more people using personal computers for CAD, desktop publishing and 'multimedia' applications, which can involve quite large files for images, video and sound recordings, there was clearly a growing need for transportable media with significantly greater capacity than traditional 'high density' floppy disks. A capacity of 1.2MB or 1.44MB might have been more than enough 15 years ago, but even using the various innovative compression systems that have appeared since then, it is now woefully inadequate. Why, a single medium-resolution colour image of modest size can reach 18 or 20MB!

Of course a variety of higher-capacity media have been developed in recent years, including drives designed to accept removable cartridges containing either small reels of magnetic tape or hard disk platters. And although many of these systems have been used in reasonable quantities by different sectors of the overall market, most of them turned out to have had shortcomings which limited their appeal — especially among PC users.

For example tape cartridges have the shortcomings of any tape medium, in that they are inherently 'linear access' rather than 'random access'. This results in long access times and makes them really only suitable for use as an archiving medium.

Removable hard disk cartridges like the Syquest 44MB and 88MB cartridges used in the publishing industry provide true random access and faster access times, making them more suitable as a file transport medium. However they've been relatively high in cost (around \$75 per cartridge), limiting their appeal for low-end and personal use.

No doubt that's why US firm Iomega Corporation, based in Roy, Utah, made such an impact when it came out with the new ZIP drive and its compact, low cost removeable 100MB disks. It was

one of those developments that arrived just at the right time, and with just the right combinations of features to ensure that it would 'sell like hot cakes'...

The ZIP drive itself is a little larger than a 3.5" floppy drive, but the disks themselves measure a mere 98 x 99 x 6mm — only a little larger than a 3.5" floppy. They're even more rugged than a 3.5" floppy, too, making them very suitable for use as a transport medium.

But perhaps the biggest appeal of these new Zip disks is that despite providing the same capacity as around 70 high density floppy disks, even in Australia they cost only around \$25 each — less than the cost of 20 reasonable-quality floppies!

Iomega make two different external versions of the Zip drive itself, one designed for connecting to the computer via a SCSI controller and cable, and the other via a standard Centronics-type parallel printer port. There's also an internal version of the drive, again with SCSI interface.

The external drives measure 135 x 180 x 36mm (W x D x H), and can be used either horizontally or vertically. They're powered by their own separate in-cord power supply, which provides 5V DC at 1A. The drives have a green power LED and an orange activity LED, and the only user control is a small pushbutton used to release and eject the currently loaded disk.

## Trying one out

Our attention was drawn to the Zip drives recently when Iomega's Australian distributor Polaroid Computing was running an introductory promotion via major dealers — including Dick Smith Electronics. As part of the promotion firms like DSE were offering a 'Starter Pack', containing either a SCSI or Parallel-Port external drive, together with a total of five Zip disks, a six-disk 'organiser' rack, a soft carrying bag and a bonus pair of

Polaroid sunglasses — all for only a little over \$400, and with a \$50 'cashback' offer to boot.

It seemed like such good value for money that we asked DSE if they'd send one over, so we could use it to evaluate the Zip drives on your behalf. Hence this review...

We asked for a Parallel-Port version of the Zip drive, because we reasoned that we'd be able to try this version out easier with a number of different PCs. This turned out to be right, although the experience was not without its hassles.

The main hassle was right at the start, because when we took everything out of the box and looked for a user manual, we discovered that there wasn't one in the traditional sense. The manuals only existed as files — on either the 3.5" floppy that contains the install/setup software, or on the 'Zip Tools' disk that contains the Iomega utilities. Clearly one has to have installed the driver software already, before one can read anything on the latter, so it clearly wasn't going to be of much help when it came to installation.

Oh, there *was* some 'hard copy' instruction material supplied, in the form of two small folded brochures, one marked 'Installation Guide' and the other 'User's Guide'. However although these were both marked clearly 'Parallel Port' on the *outside*, when you turned inside to read the fine details about installation, you discovered that almost immediately they began to talk about hooking the SCSI cable up to your Macintosh and installing the Mac software!

Perhaps there had been a printing error with the brochures for this batch of Parallel-Port Zip drives, or perhaps they're all like that. Either way we found it rather irritating and confusing, and we suspect a lot of other people would find it likewise. In fact it would probably put *some* potential users off Zip drives altogether, which in our opin-



**One of Iomega's Zip drives complete with its power supply (top centre), connecting cables, floppy disk containing installation software, brochures and a 100MB Zip Tools disk containing handy utilities. The additional Zip disks at left were only included in the Starter Pack.**

ion would be quite unfortunate...

In our case we persevered, reading first the README.TXT file on the install floppy, and then other files we found there such as GUESTHLP.TXT and MANUAL.EXE (a self-executing manual/viewer). Gradually it became clear that the parallel-port Zip drive is still essentially a modified SCSI drive, which happens to connect to the computer via the Centronics port. Custom ASPI drivers are used to 'find' the drive and communicate with it, via this port rather than the usual SCSI controller. In the simplest case, a driver called GUEST.EXE can be loaded and used to communicate with the drive, either in an ad-hoc way (when running the drive temporarily on a different computer, for example), or permanently by calling it in your AUTOEXEC.BAT file. It can be loaded into high memory.

Once we had twigged onto this, it didn't take long at all to run GUEST.EXE and begin using the Zip drive. We soon discovered that when it fires up GUEST.EXE scans your system, and once it has found the Zip drive automatically allocates it the next available drive letter — on the main machine we tested it with, it became drive 'F:' as we already had two hard disks and a CD-ROM drive.

In either DOS or Windows (3.11) we could then access the new Zip drive, and read or write to a disk. We could also

access some of the additional manual files on the Zip Tools disk, and finally install from it the Iomega Utilities program. This has the utilities to let you format Zip disks, do copying of complete disks to/from Zip disks, perform diagnostic checks of the Zip drive and/or disk, lock/unlock disks, eject them without pressing the manual button on the drive, and so on.

So in the long run, it actually turned out to be relatively easy to install the Zip drive and get it going — but no thanks to those rather scrambled brochures!

Once it was installed and going, everything was quite smooth sailing. And considering this version's slightly awkward interfacing via the printer port, its performance was still quite impressive. Copying an image file of 12.6MB from one of the hard disks (seek time 13.7ms, transfer rate 1.4MB/s) to a Zip disk took almost exactly 100 seconds, giving an average transfer rate of just on 129KB/s. (It can apparently transfer faster, at up to about 330KB/s, if you're using an EPP-type parallel port, which we weren't.)

Similarly opening the same file from the Zip drive in Picture Publisher V.5, running under Windows 3.1, took 113 seconds compared with 12 seconds from directly the hard disk. So it's certainly slower than a modern IDE hard drive, but in our opinion still quite acceptable

for the intended purpose as a medium for archiving and file transfer.

The other important aspect of performance we wanted to check was whether there was any potential conflict between the Zip drive and a printer, when they're using the same parallel port. (The Zip drive has a second DB-25 socket on the rear, effectively duplicating the port for use by a printer.) We couldn't find any mention of this possibility in the electronic manuals, suggesting that Iomega had either not considered it (unlikely) or had simply made sure it couldn't happen.

We tried this out on a number of different machines, by printing out both images and a Quark document containing images, graphics and text, to various printers on the same port as the Zip drive. In each case there were no apparent glitches or problems — even when we tried 'tempting fate' by printing a Quark document using the aforementioned 12.6MB image on the F: drive, so that Quark would have to interrupt its printing to grab image data from the Zip disk. Things just took a little longer, that's all...

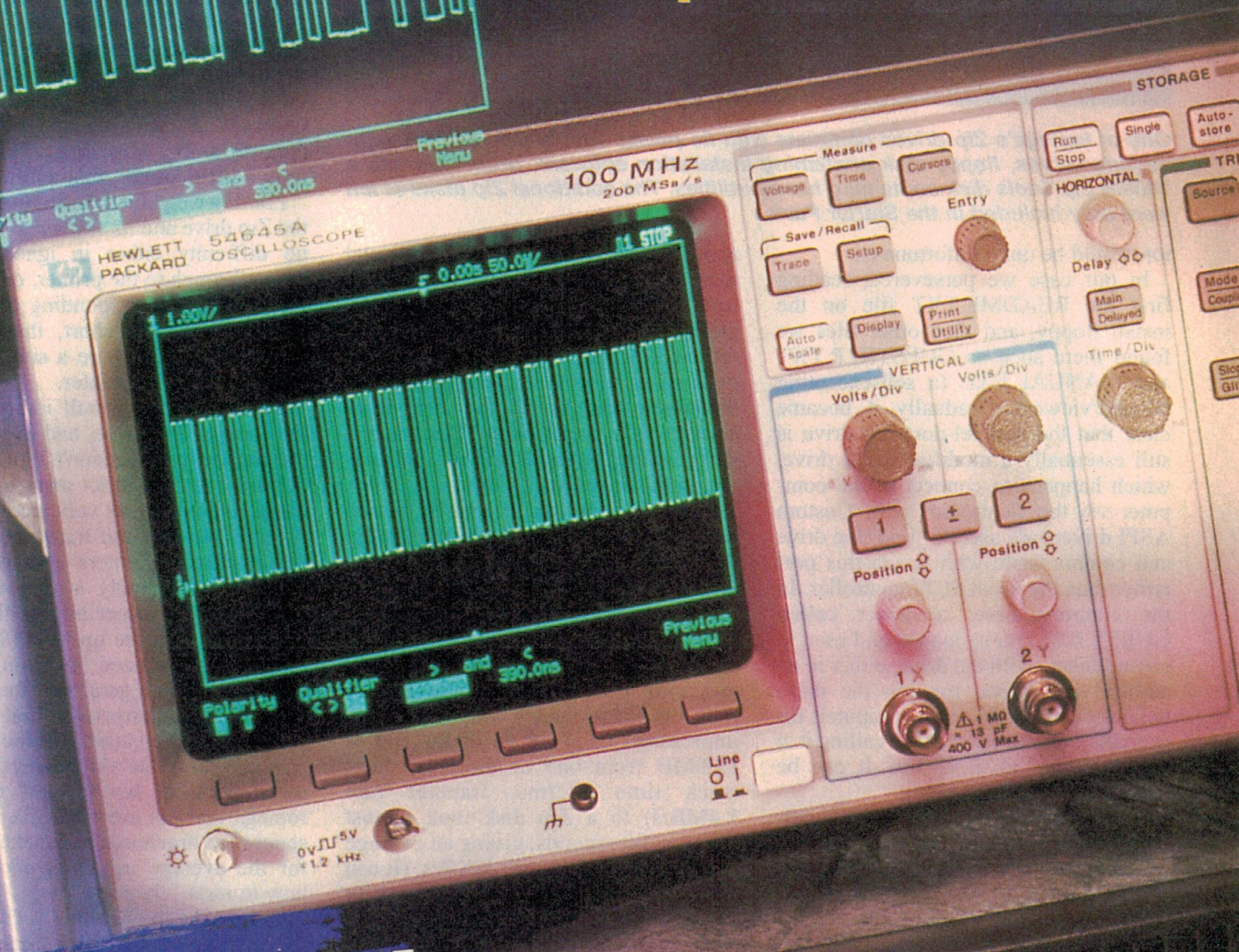
Frankly we gained the impression that the Zip drive and its software drive have no difficulty either in ignoring stuff going through to the printer, or stopping the printer from responding during Zip disk transfers. In short, that the Zip drive can indeed share a single printer port safely with a printer.

So what's our overall impression of the Iomega Zip drive, and in particular the parallel-port version? In a nutshell, the drive and its disks seem to be well made, and they work very nicely indeed. As an archiving and transport medium for modern computers and their large files, they're clearly a very attractive proposition — especially at the price. Being able to store up to 100MB on a rugged floppy-sized medium costing less than \$30 is a great step forward.

We're not surprised that they're already pretty popular. But the parallel-port version is likely to be a heck of a lot more popular, we feel, if only Mr Iomega and his crew can fix up those scrambled brochures and make it easier for the average user to work out just how to install the jolly thing!

Our thanks to Dick Smith Electronics for making a Zip drive Starter Pack available for review. We understand that the Starter Pack won't be available by the time you read this, but apparently the various standard Zip drive packages will be available at all DSE outlets, including the new PowerHouse store, for around \$349.00. ♦

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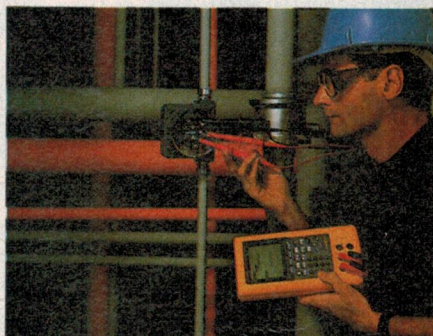
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# NEW PRODUCTS

## TEST EQUIPMENT

### Instrument calibrator enhanced

Fluke has enhanced its 700 series of documenting process calibrators (DPCs) with the addition of two new models — the 741 and 743. The new models feature enhanced hardware and firmware, new DPC/TRACK software and new pressure modules.



The 700 series was introduced in 1994 for use in maintaining and calibrating process control instrumentation in process industries such as chemicals, petroleum, primary metals, pulp and paper, as well as in utilities, electrical/electronic manufacturing, and industrial machinery.

New embedded software, including user-entered values for both source and measure, makes it possible to document the calibration of display-only devices such as panel meters. The 'custom units' feature allows the 740 series to work with millivolt output accessories and to document tests with units such as parts per million, revolutions per minute, and more.

For further information circle 241 on the reader service coupon or contact Philips Test & Measurement, 34 Waterloo Road, North Ryde 2113; phone (02) 9888 0477.

### Signal source has atomic clock accuracy

Novatech Instruments has announced its 2955AR rubidium standard. The instrument has a direct digital synthesised output that is 32-bit



programmable from 10Hz to 4MHz. It also has fixed outputs of 10MHz and 1MHz. Output programming is done using an RS-232 serial interface, and the output frequency can be saved in EEPROM memory so it returns to a stored value after a power shutdown.

The output has excellent spectral purity, with typically less than -135dBc phase noise at 1kHz offset and long term stability equal to the rubidium atomic clock. The unit is suited for use in communications system applications since it can be set to standard frequencies such as the 1.544MHz T1 frequency. It can also be used as a master oscillator in laboratories and ground stations as well as for test and calibration. The instrument is priced at US \$4295.

For further information circle 242 on the reader service coupon or contact Novatech Instruments Inc., 1530 Eastlake Avenue East, Suite 303 Seattle, WA (USA) 98102; phone (206) 322 1562, or email at [novatech@eskimo.com](mailto:novatech@eskimo.com). (WWW site at <http://www.eskimo.com/~ntsales>)

### RCL meter connects to a PC

Fluke's new PM6306 RCL meter features a large LCD, variable test frequencies up to 1MHz, and variable



AC/DC voltages for manual or automated passive component testing. To use the meter, you simply connect a component to the test posts and the instrument shows an instant read-out of dominant and secondary values, as well as the equivalent circuit diagram.

The test frequency is continuously variable from 50Hz to 1MHz, to suit products such as switch-mode power supplies, or low-value capacitors and inductors. It also has continuously variable AC/DC voltage scales, making the instrument suitable for analysing the frequency or voltage behavior of components, and for testing components under their true operating conditions.

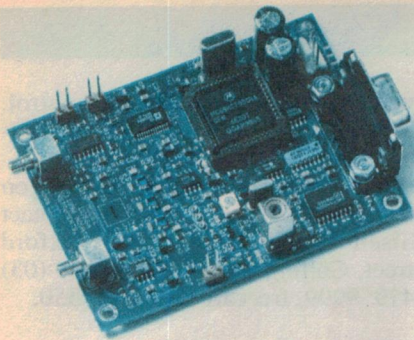
The instrument can be used in an automated component testing environment, at up to 10 measurements per second when connected to a PC via an IEEE-488 interface. A binning function allows components to be sorted into as many as ten bins. For stand-alone testing, it can be controlled via an RS-232 interface.

For further information circle 243 on the reader service coupon or contact Philips Test & Measurement, 34 Waterloo Road, North Ryde 2113; phone (02) 9888 0477.

### RS-232 controlled 40MHz synthesiser card

The DDS6m direct digital synthesiser module from Novatech Instruments is a 40MHz signal source on a 63.5 x 90mm circuit board. It provides both sine and clock output signals simultaneously and is RS-232 programmable from 100Hz to 40MHz in 0.025Hz steps. The frequency setting can be saved in EEPROM memory so it returns to the saved value after a power interruption.

The output has excellent spectral purity with a typical phase noise value around -125dBc at 1kHz offset. The timebase is jumper selectable between an internal 5ppm crystal oscillator or an external clock input. The phase of the output signal is programmable in 11.25° increments. Multiple cards can be phase synchronised when used with an external



clock. The cost of the card is US\$295.

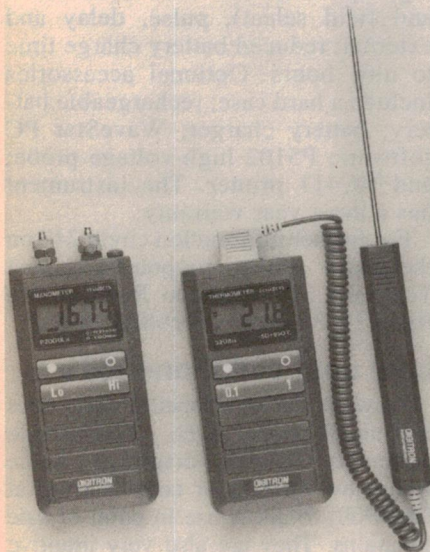
For further information circle 244 on the reader service coupon or contact Novatech Instruments Inc., 1530 Eastlake Avenue East, Suite 303 Seattle, WA (USA) 98102; phone (206) 322 1562, or email at [novatech@eskimo.com](mailto:novatech@eskimo.com). (WWW site at <http://www.eskimo.com/~ntsales>)

### Portable, safe thermometer & manometer

Intrinsically safe versions of some Digitron hand-held thermometers and manometers are now available. The instruments are certified to EEx ia IIC T5, and are claimed to be highly accurate, robust and simple to use. The instruments come in a water resistant casing, and a rubber protective jacket is also available.

All instruments are certified for use in inflammable or explosive atmospheres up to Zone 0. The BASEEFA certification is equivalent to EN50 014 (1977) + A1 to A5, EN50 020 (1977) + A1 and A2. Each instrument is supplied with a copy of the certificate (Ex. 88C2445/6).

Two thermometers are available: one that measures from  $-50^{\circ}$  to



$+199.9^{\circ}\text{C}$ , the other with a measurement range of  $-50^{\circ}$  to  $+950^{\circ}\text{C}$ . The P200 manometer series has six ranges, and are suited for use with non-corrosive, non-ionic liquids and gases. Liquid pressure can be measured with an air buffer.

For further information circle 245 on the reader service coupon or contact Zenology Sales P/L, Suite 7, 1st Floor, 245 Springvale Road, Glen Waverley 3150; phone (03) 9802 0599.

### Audio analyser

The Kenwood VA-2230 Audio Analyser combines the functions of a low frequency signal generator (10Hz to 110kHz), electronic voltmeter, distortion meter, frequency counter and DC voltmeter. The instrument is provided with a GPIB interface for external programming and data output.



Features include measurement of true RMS values, high speed signal generation using direct digital synthesising, SINAD measurement, dual channel input/output measurement for cross talk, separation and L/R ratio, frequency counter and extended AC level frequency range to 210kHz, distortion meter with THD and harmonic analysis functions (2nd to 10th harmonic).

For further information circle 246 on the reader service coupon or contact Nilsen Technologies, 150 Oxford Street, Collingwood 3066; phone (03) 9419 9999, freecall 1800 623 350.

### Low cost test instruments

The CIE series of test equipment includes four handheld multimeters, two thermometers and a current clamp for general electronic service, automotive service and education. The series includes two card-type digital multimeters, models 111 and 113, that feature compact size and single-handed operation. They measure AC and DC volts, resistance and continuity.

Included also are two low cost digital multimeters, models 125 and 125C. These have an analog bargraph, a 3200 count display, auto or manual range selection and an auto power-off function. They can both measure AC and DC voltage, and the 125 has current ranges including a

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The system software of the Wavetek 4100 series is easily updated by connecting the instrument to a PC. These updates will be available via the Internet.

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## NEW PRODUCTS

fused 10A range with safety warning beeper. The 125C incorporates a capacitance measurement function.

The CIE 305 and 306 are digital thermometers with single and dual thermocouple inputs, respectively. These instruments measure temperature to an accuracy of 0.3% from -50 to +300°C, using type K thermocouples. The measurement can be selected as either Celsius or Fahrenheit and is displayed on a 3.5-digit LCD.

The CIE 8088 and 128 are for automotive troubleshooting and include RPM measurement; dwell angle for four, five, six or eight cylinder engines; frequency and temperature; as well as the usual voltage, current and resistance measurement ranges. Both have fused current ranges of 20A and 10A respectively.

The CA-600 is an AC/DC current clamp with two Hall effect sensors. It can be used with any DMM and has a 1000:1 transformer producing an output of 1mA per ampere, and will accommodate conductors up to 30mm in diameter.

For further information circle 247 on the reader service coupon or contact Obiat, PO Box 37, Beaconsfield 2014; phone (02) 9698 4111.

### 20MHz function generator

The new Thurlby Thandar function generator TG120 has a frequency range of 0.2Hz to 20MHz over eight ranges. It can be used in sweep mode (with an external sweep source), and provides a sweep range of at least 20:1. Wave shape outputs include sine, triangle, square and DC level waveforms, as well as variable duty cycle and sawtooth pulses. The instrument has a main output of 20 volts peak-to-peak (from a 50Ω source impedance).

A two step attenuator (20dB/step) and a 26dB range vernier provide levels down to 10mV peak-to-peak. A variable DC offset of +10V is

available via a centre detent control. An auxiliary 0 - 5VDC level is available for TTL and CMOS loads.

For further information circle 248 on the reader service coupon or contact Nilsen Technologies, 150 Oxford Street, Collingwood 3066; phone (03) 9419 9999, freecall 1800 623 350.

### 200MHz handheld scope



Tektronix has released its new THS730A handheld oscilloscope, claimed to offer the highest bandwidth and sampling speed currently available. The instrument includes isolated channel architecture to ensure safety of the user and the equipment under test. This architecture was developed as the safest method to test and measure various combinations of power voltages. The dual channels/dual digitisers truly isolate the power sources, yet keep the timing relationship intact so measurement is possible.

Specifications include 200MHz bandwidth and 1GS/s digital real-time (DRT) sampling rate; an intuitive graphical user interface; triggering capability for video (line count and field select), pulse, delay and external; reduced battery charge time to nine hours. Optional accessories include a hard case; rechargeable battery; battery charger; WaveStar PC software; P5102 high-voltage probe; and HC411 printer. The instrument has a three year warranty.

For further information circle 249 on the reader service coupon or contact Tektronix, 80 Waterloo Road, North Ryde 2113; phone (02) 9888 7066.

### Low cost cellphone testers

Wavetek has developed a new series of cellular phone testers which enable extremely accurate diagnosis, while being low enough in cost (starting at DM5900) to allow use in point of sale situations. They are also very intuitive



to use, allowing use by non-technical personnel.

At its first level of diagnosis, called AUTOTEST, the Wavetek 4100 series checks all essential functions quickly and accurately in Go/NoGo fashion, and picks up genuine faults immediately. If such a fault is found they then enter FAULT FIND mode, performing specific tests to locate possible causes. As a result, minor faults can be repaired on the spot or a detailed fault protocol can be passed on to the repair service.

All models in the series have a compact and handy design, and are based on state of the art VLSI and DSP chips. Menu-driven operation, an uncluttered keypad and integrated help functions make the units very easy to use. The testers can communicate with PCs, printers and modems via RS-232C or Centronics interfaces.

For further information circle 262 on the reader service card, or contact Scientific Devices Australia, 118 Atkinson Street, Oakleigh 3166; phone (03) 9569 1366 or fax (03) 9563 4728.

### Rubidium-based calibrator

Fluke's new PM6681R rubidium frequency reference/calibrator allows time and frequency calibration to be done in either a calibration lab or on site. The instrument has a rubidium atomic frequency reference, an integrated 10MHz frequency reference and six buffered outputs.

By using an external receiver, the calibrator can also monitor the GPS frequency over a long-term period and compare it with its own atomic reference. In this way, the unit becomes a fully traceable time and frequency calibrator, with traceable stability over long-term, 24-hour, and short-term periods.

The calibrator is suitable for labs that don't have a primary caesium reference, or where a rubidium reference is preferred because of its long lifetime and lower cost. Its warm-up period of six minutes to reach an accuracy within  $1 \times 10^{-9}$  or 10 minutes to reach  $1 \times 10^{-10}$  makes the unit suited for on-site calibration. It has a frequency drift of less than  $2 \times 10^{-10}$ /year, which allows the unit to be used as a primary reference for calibration labs, operating to a traceability level of  $1 \times 10^{-9}$ .



The instrument is available in versions that calibrate frequencies up to 4.5GHz. It can also calibrate all digital counter functions and phase meters up to 160MHz. It comes with Fluke's TimeView software that handles time and frequency analysis and advanced statistical processing in the modulation domain. These features add extra capabilities such as analysing jitter and modulation, locating hidden noise sources, characterising frequency sweeps, plotting agile frequency sources (frequency versus time), analysing VCO transient responses, and viewing frequency-locked-loop dynamics.

For further information circle 250 on the reader service coupon or contact Philips Test & Measurement, 34 Waterloo Road, North Ryde 2113; phone (02) 9888 0477.

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## COMPONENTS

### PCB mount 10kV reed relays

Kilovac Corporation has announced the addition of flying lead models to its line of high voltage reed relays. The new models are PC board mount, but avoid the need to have high voltage connections directly on the PC board as they are fitted with 300mm high voltage leads.

Power handling for the new relays is 5A continuous at up to 10kV isolation, and the relays can switch loads up to 500 watts. Part of the Kilovac S05LT series, these relays are available in both form A SPST-NO, and form B SPST-NC, with a choice of 5, 12, or 24V DC coils. Dimensions are 60 x 15.7 x 18.3mm.

For further information circle 253 on the reader service coupon or contact Captron P/L, PO Box 884, Brookvale 2100; phone (02) 9905 5888.

### UL94V-0 rated terminal blocks

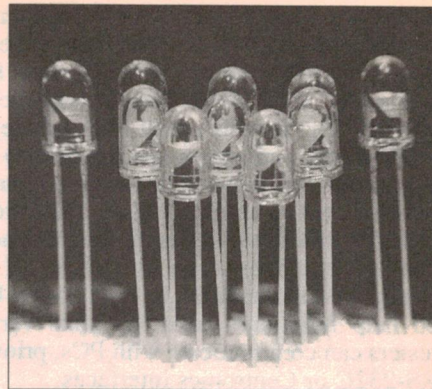
The new circuit board mounting DBL series of terminal blocks from

Augat have a dual-pin configuration that gives two connections per terminal to the PCB, eliminating the need for mounting screws. The new blocks are available in four, six and eight terminal versions, and feature raised wire-clamping screws. They have a tri-barrier construction surrounding the connection on three sides, and there are standoffs for flux removal.

The barrier is fabricated from polypropylene, with UL recognised flammability classification 94V-0, and a maximum operating temperature of 105°C. The terminals are of bright acid tin over copper plated brass. The 4DBL, 6DBL and 8DBL series are rated at 20A (150/300V), 25A (300V) and 30A (300V) respectively.

Used with Augat's press-fit covers, the new terminal blocks can be used in applications requiring 'finger safe' construction. Typical applications include fire alarm security products, including fire alarm horns and strobes. The DBL series can be supplied up to 30 positions in length.

For further information circle 251 on the reader service coupon or contact Augat P/L, 3/1 Vuko Place, Warriewood, 2102; phone (02) 9913 7100.



### High output IR LEDs

Three new infrared light emitting diodes are available from Allthings Sales & Services. The LEDs are suitable for high output video camera IR illuminators, IR remote control and IR communication (IrDA PC) links. Each LED has particular characteristics to suit the different requirements of these applications. Main parameters are: up to 52mW/steradian (continuous) radiant intensity; radiation angles from 24 to 60°, spectral radiation wavelength from 800 to 950nm, standard 5mm diameter transparent (water clear) packages.

All are suitable for CCD video camera infrared illuminators. The 925-950nm

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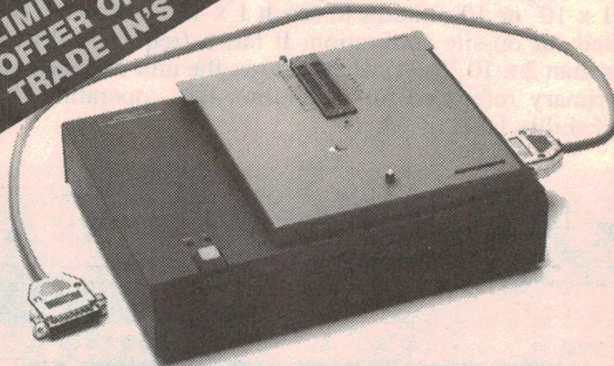
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device has a continuous radiant intensity of 50mW/sr at 100 milliamps, and for remote control of IR links up to 500 mW/sr when pulsed at 1A. For IR illuminators the radiation angles of 24, 50 and 60° allow close matching to the field-of-view of the video camera lens with the illuminator radiation angle.

The 800-850nm LEDs are especially suited for IR illuminators as the sensitivity of a typical silicon CCD image sensor peaks at around 830nm. These LEDs have a high output and high efficiency, and an output of 52mW/sr continuous at 50mA. In packets of 50, the LEDs are priced between 20 and 70 cents each.

For further information circle 252 on the reader service coupon or contact Allthings Sales & Services, PO Box 25, Westminster 6061; phone (09) 349 9413.

## 15kV load switching relays

Kilovac has introduced two new compact 15kV vacuum relays that can switch load currents up to 17A. Most high voltage relays are specifically designed to isolate high voltages, but not to switch while under load (i.e., power switch). However, many applications that need high voltage relays also require them to power switch. As well, power switching can occur because of a fault or operator error.

Kilovac's new KC-14 and KC-18 relays are specifically designed to power switch various loads and isolate voltages up to 15kV. The relays can switch 17A at 330V DC and 1A at 10kV DC, up to 10,000 times and

50,000 times respectively.

For further information circle 255 on the reader service coupon or contact Captron P/L, PO Box 884, Brookvale 2100; phone (02) 9905 5888.

## CFC-free dust remover

Richard Foot has announced the release of Dust-Off, an aerosol product for removing dust and other debris from electronic, electrical, photographic, and computing equipment, as well as printer mechanisms, fans, copiers etc.

This Australian product is 100% CFC free and has no ozone depleting constituents in its formulation. It therefore meets the most stringent international requirements for this type of product, and is below the levels of 'low ozone' depleting products currently available. Because it is non-flammable it can be used in hazardous areas.

For further information circle 256 on the reader service coupon or contact Richard Foot Pty Ltd, 14/2 Apollo Street, Warriewood 2102; phone (02) 9979 8311.

## POWER SUPPLIES

### 30V/5A benchtop power supply

The new 305LDD benchtop power supply has an adjustable output of 0 - 30V DC with a peak current of 6A and a continuous output current of 5A. The output voltage has fine and coarse adjustments, and the voltage is displayed on a digital LCD panel meter.

## NOTES & ERRATA

**STROBOSCOPIC TUNER** (May 1996): There's a slight confusion between eights and zeros in the circuit diagram — R22 should be 10k as shown in the parts list, not 18k as printed in the diagram, and also the circuit diagram shows an 'R28'; this should in fact be 'R20'.

**PC DRIVEN ARBITRARY/FUNCTION GENERATOR** (December 1996): Due to the discovery of malfunctioning with some static RAM chips, and also with some PC printer ports, this project has been put 'on hold' while we sort out the problems. We hope to continue its description shortly. ♦

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## SMD - DIODES, I.C., TRNS

BAS16	75V 100mA	0.04
BC848BLT1	NPN 30V 100mA	0.05
LM339MX	L/Pwr Low O/set V. C/par.	0.20
LM358D	Low Power Dual Op. Amp.	0.15
LM78L05	+5V 100mA TO-92 REG.	0.10
MMBTH10LT1	25V 4mA 0.56Gig RF Amp.	0.10
NM93CS06M8	Serial EEPROM 16 x 16	0.50

## CRYSTALS

6 MHZ	0.90
8 MHZ	0.60
10 MHZ	0.40



## EPROMS

27C512-12	CMOS 64K x 8	3.00
27C256-15	CMOS 32K x 8	2.50

## INTERGRATED CIRCUITS

LF444	Quad L/Pwr JFET Input Op. Amp.	0.50
XR567	Tone Decoder	0.20
MC34119P	Audio Amp 250mW	0.25
NE555	Dual Bipolar Timer	0.25
4093	Quad 2-Input NAND Schmitt Trigger	0.15
4538	Dual Prec. Monstable M/vibrator	0.15
74LS240	Octal Bus/Line Dve, Invert. 3-St	0.15
74LS244	Octal Driver, Non-Invert, 3-State	0.20
74LS259	8-Bit Addressable Latch (9334)	0.20

## MISCELLANEOUS

BAT42	30V 0.2A <5ns Schottky Diode	0.10
CNY17-4	630V 160....320 % Opto Coupler	0.30

## TRANSISTORS/FETS.

BC547	NPN 45V 0.1A 500mW TO-92	0.04
BC548	NPN 30V 0.1A 500mW TO-92	0.04
BS72A	N-Mosfet 80V 0.3A 0.8W TO-92	0.15
BUZ42	N-Mosfet 500V 4A 75W TO-220	1.50
IRF830	N-Mosfet 500V 4.5A 74W TO-220	1.70
MPSA42	NPN 300V 0.5A TO-92	0.06
PN2222	40V 0.8A 0.6W 300MHz TO-92	0.04
PN2907	PNP 60V 0.6A TO-92 G/P	0.04
VN4012L	FET 400V 0.16A TO-92	0.25
2N6517	NPN 350V 500mA 625mW TO-92	0.10
2N6520	PNP 350V 500mA 625mW TO-92	0.10

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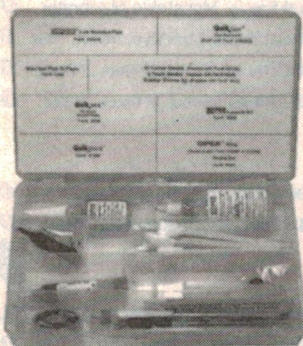
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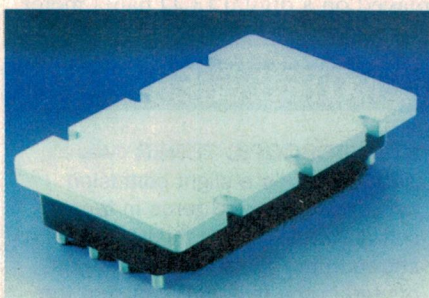
The output has  $\pm 2\%$  load regulation with 100mV peak-to-peak ripple (max). A second digital LCD panel meter displays the current value. Variable over-current protection is controlled from the front panel. The supply is housed in a sturdy metal case, allowing units to be stacked vertically.

For further information circle 257 on the reader service coupon or contact Computronics International, PO Box 8076, Perth Business Centre, Perth 6849; phone (09) 221 2121.

## Auto ranging AC-DC module

The new VI-ARM auto ranging rectifier module from Vicor Corporation houses the entire front end of a switching power supply. The new unit delivers up to 750 watts at 180-264VAC from a package measuring 36.8 x 57.9 x 12.7mm. The user needs to add a filter and a holdup capacitor to suit the application.

When used with Vicor DC-DC converters, the module provides a high power density, low profile, off-line switching power source from the AC mains supply, in a compact package.

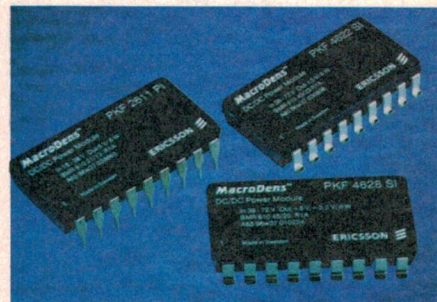


Optional EMI filters are also available, designed to provide 6dB of margin relative to EN55022 when used with the VI-ARM and with Vicor DC-DC converters.

For further information circle 258 on the reader service coupon or contact Powerbox Australia, 4 Beaumont Road, Mt Kuring-gai 2080; phone (02) 9457 2200, or email to [sales@powerbox.com.au](mailto:sales@powerbox.com.au).

## 50 to 150W power modules

Ericsson Components has announced a new family of high efficiency power modules in the 50W to 150W power range. The PKT series consists of isolated single-output models with output voltages of 2.5V, 3.3V, 5.1V, 12V and 15V and with output power levels of 50W, 75W, 100W and 150W. The 2.5V modules are available with power ratings up to 75W and



the 3.3V modules up to 100W.

The power modules are packaged in the widely used 'half-brick' format with an industry standard pin-out. They are intended for 48/60V DC systems according to ETSI prETS 300132-2 and have an input voltage range of 36 to 72V DC. Features include a baseplate temperature rating of 100°C, 84.5% typical efficiency (5.1V 150W unit), high reliability, active current sharing and a range of control and monitoring functions.

Two versions of the power modules are offered to address various levels of system complexity. One version provides a basic set of control functions including remote control, adjustable output voltage, remote sensing and thermal shutdown. The full-featured version expands the above functions with the addition of a module OK signal, adjustable current limit, secondary side remote control, adjustable over-voltage limit, thermal warning and active current sharing.

For further information contact Ericsson Limited, 12/F Devon House, 979 King's Road, Quarry Bay, UK; phone (UK) 2590 2388.

## High reliability DC/DC power modules

Ericsson Components has released five new models in the 3-7W PKF series of MacroDens DC/DC power modules. Included are 24V input and dual output types. The modules are compatible with fully aqueous in-line, and semi-aqueous batch cleaning processes. Both the



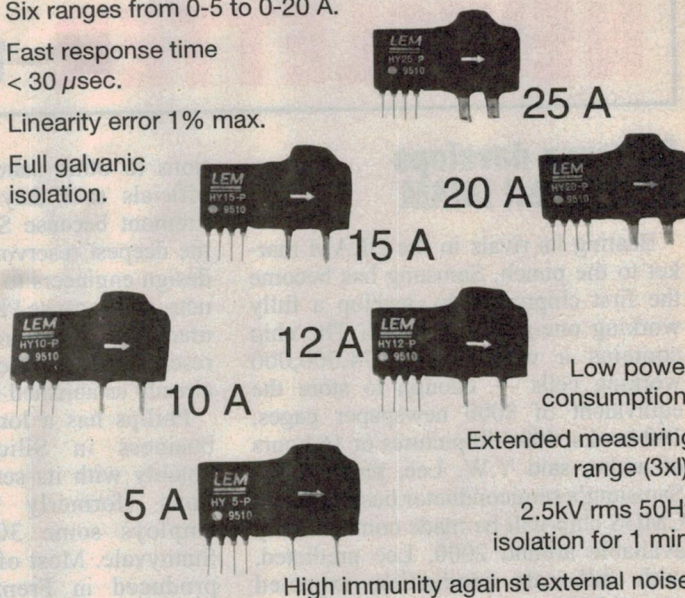
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through-hole and SMD versions are normally supplied in tubes. The SMD version is optimised for automated mounting and is also available in standard JEDEC dimension tray.

The 24V input family has a 5V output version, and a 3.3V version, targeting cellular radio, industrial and medical applications. For 48V/60V powered systems, dual output voltages of +3V/+5V and +/-5V are available, targeting information technology and telecoms applications.

For higher power applications, units can be connected in parallel. Operating temperature range for the series at full power is -45 to +85°C. Reliability performance is more than 560 years MTBF.

The MacroDens package is claimed to guarantee optimal performance in demanding applications and complies to IEC 68-2 testing procedures in salt mist, sulphur dioxide and hydrogen sulphide.

For further information contact Ericsson Limited, 12/F Devon House, 979 King's Road, Quarry Bay, UK; phone (UK) 2590 2388. ♦

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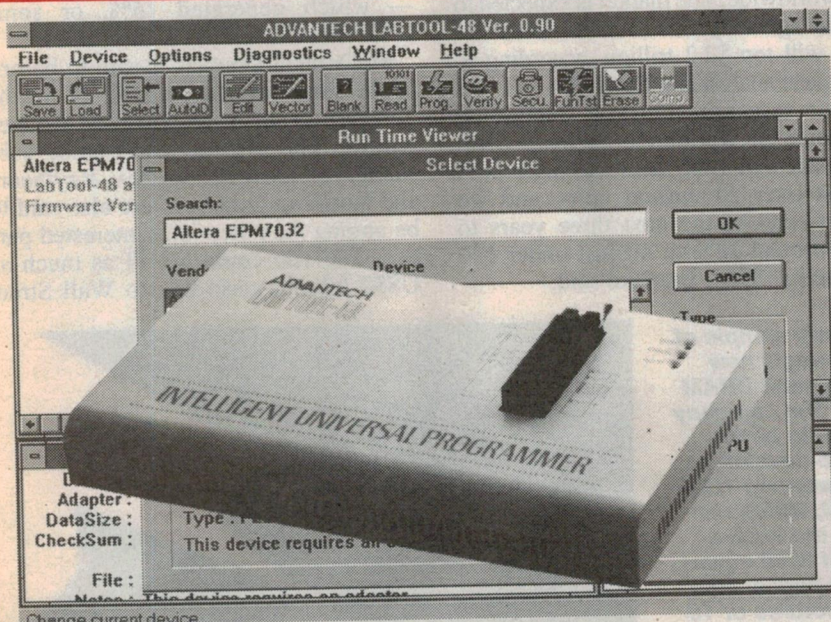


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READER INFO NO.28

# Silicon Valley NEWSLETTER



## Samsung develops one-gigabit DRAM

Beating its rivals in the DRAM market to the punch, Samsung has become the first chipmaker to develop a fully working one-gigabit DRAM. The chip contains a whopping 1,074,000,000 working cells — enough to store the equivalent of 8000 newspaper pages, 160 books, 400 still pictures or 16 hours of audio, said Y.W. Lee, president of Samsung's semiconductor business. The CMOS chip will be made commercially available around 2000, Lee predicted, with full-scale production expected around 2003.

In Japan, NEC and Hitachi have developed prototype 1Gb chips, but they are not working models that can be transferred to production. NEC said late in 1995 that it expects to be able to distribute samples of its 1Gb DRAM chip in 1998 and begin mass production in 2000.

Samsung has invested some US\$272 million in the development of the chip, which took 120 key researchers 2.5 years to build. It is based on 0.18µm design rules, runs from a 1.8 - 2.0V power supply and has an operating speed of 30ns. The die has an area of 570mm<sup>2</sup>.

## Philips to make cellphones in Valley

Typically, high-tech companies in Silicon Valley move their production out of the area after they get big enough. That's what attracted interest in the move by Dutch electronics giant Philips to set up a major cellular telephone manufacturing operation in Fremont.

Philips said its Consumer Communications group broke ground in November on a US\$125 million, 18,600m<sup>2</sup> manufacturing site, its first cellular-phone factory in the Western Hemisphere. Several hundred people will be employed at the site, where they will be making cellular phones, mobile phones and pagers. Philips hopes to be producing within a year.

Philips officials said they were not concerned about the high cost of living in Silicon Valley, which has caused most of the area's high-tech industry to move commodity manufacturing opera-

tions to other states, or offshore. The officials said they chose to build in Fremont because Silicon Valley offers the deepest reservoir of electronics and design engineers to create its new products, and because Philips wants the manufacturing operations to be near the research and development efforts it has already established in the valley.

Philips has a long history of doing business in Silicon Valley, most notably with its semiconductor operations (formerly Signetics), which employs some 3000 employees in Sunnyvale. Most of the products to be produced in Fremont will be sold throughout North and South America.

## Electronics market \$1.2 trillion by 2000

Consumers and businesses will consume in excess of US\$1.2 trillion dollars worth of electronics products in the year 2000, it's predicted by market researchers at Dataquest in San Jose.

The forecast means the market for high-tech electronics gear will nearly double from 1995, when it reached US\$750 billion worldwide. The market is expected to double again by 2010 when electronics sales will top \$2.2 trillion, according to Dataquest analyst Jim Eastlake.

"Our research shows a continuing explosion in worldwide personal computer sales. In 1996 sales will jump 20% to just over 70 million units, and we expect each of the next three years to grow around 18% to hit just under 120 million in 1999", Eastlake said.

*An early sample of Samsung's new one-gigabit DRAM chip. The company claims to be the first to develop a fully working 1Gb DRAM, which can store the equivalent of 8000 newspaper pages, 400 still pictures or 16 hours of audio. It's expected to be commercially available around the turn of the century.*

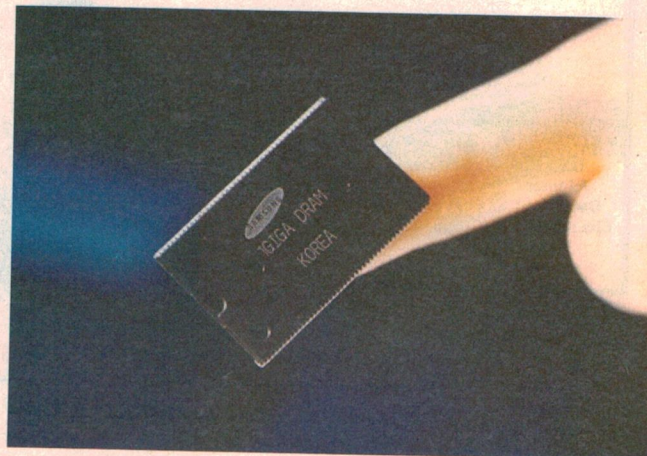
Industry observers were quick to emphasize that the Dataquest forecast is just that. In September 1995, Dataquest predicted a DRAM surplus through 1998 and a US\$350 billion semiconductor market in 2000. Three months later, chipmakers were peddling DRAMs for 70% below September prices. The chip market forecast has since shrunk to around US\$200 billion in 2000, according to the Semiconductor Industry Association.

Eastlake said, however, that Dataquest still believes the chipmarket will reach US\$310 billion in 2000, and \$700 billion in 2005. The firm also believes that the Asia/Pacific region, minus Korea and Japan, will consume 30% of all electronic goods — a fraction ahead of the United States — with Europe and Japan each slightly over 20%.

## TI getting out of defence business?

Texas Instruments may narrow the scope of its business interests, as the Dallas-based electronics giant is believed to have begun selling off part or all of its long-time defence business — which generated 15%, or some US\$1.74 billion of TI's 1995 sales.

McDonnell Douglas is said to be one of the firms negotiating with TI for the purchase or all or some of the defence groups. The Hughes Electronics subsidiary of General Motors, Raytheon, and Northrup Grumman are also said to be among the potentially interested parties. The sale could net TI as much as US\$2 billion, according to Wall Street



analysts. TI's defence business includes sensors for missiles, advanced aircraft radars and night vision systems.

## Apple & IBM working on sub-notebook PC

Apple Computer and IBM are working on a lightweight subnotebook computer for the Japanese market, according to Apple CEO Gilbert Amelio. The system will be available in early 1997 and, depending on its success in Japan, will be marketed elsewhere.

Amelio also said Apple expects to sell about 1.1 million computers in Japan in 1997, up from 890,000 this year. "Nobody asks me anymore whether Apple will survive. We will survive, and we will prosper."

Apple will stay away from the browser war Microsoft has plunged itself into, he added. Instead, Apple will "focus on what happens when you are done browsing." This involves the development of 'knowledge management' products that help users extract information from the Internet, while preventing an information overload. So-called 'V-Twin' software will automatically collect abstracts of articles and other information items related to an area of the user's interest. At the same time, another program called 'Hot Sauce' will enable users to conduct structured searches of databases connected to the Internet.

Amelio said Hot Sauce is similar to skimming a library bookshelf.

## Sony offers desktop videoconferencing

Sony has entered the desktop PC video conferencing market with a US\$1995 'TriniCom' system which turns a PC into a video conference station, but also allows it to function as a high-speed Internet access device as well as a full-featured telephone.

The system comes with a 6mm CCD camera and runs over a single 128kb/s ISDN line. "The TriniCom system has raised the bar for desktop videoconferencing systems, offering a full range of communications capabilities", said Anthony Gargano, senior vice president of application systems for Sony Electronics' Business and Professional Group.

The TriniCom system supports high-speed Internet access via the Sony WinISDN driver, allowing up to five times the normal access rate through the ISDN interface. The system also operates as a PC-phone, allowing users to place and receive regular telephone calls from the same terminal.

Included software allows for on-screen adjustment of video quality as well as

## 'The chip recession is over...'

The worst decline in the global semiconductor market since 1985 is over, it seems. But don't tell that to manufacturers of commodity memory chips, as the memory segment will continue to suffer from excess production capacity, keeping memory prices depressed into 1998, according to the Semiconductor Industry Association — whose annual industry forecast figures show much stronger than expected growth in the global semiconductor market of 1997.

The SIA says that chip sales worldwide will grow 7.4% in 1997 to US\$138.8 billion, despite another drop in memory sales. That compares to an 11% market decline in 1996, to US\$129.2 billion from \$148.8 billion.

A faster and stronger-than-expected turnaround of the chip market, which went into a steep slump in December 1994, is being driven by strong consumer demand for a range of semiconductor-rich products such as personal computers, cellular telephones and automobiles. The demand will remain strong through the end of the century, the SIA said, when sales will reach US\$200 billion in 1999.

"1996 represents the first year of market retraction since 1985, when sales dropped 30%. However, 1996 is merely a blip on the industry's phenomenal growth record, when compared to the gut-wrenching slump of 1985", commented Thomas Armstrong, president of the SIA in San Jose. That infamous recession was the result of a sharp drop in personal computer demand, at a time when many new chip fabs came on line.

contrast, hue, brightness and colour. The system supports multiple audio devices and includes hands-free operation via the camera unit's built-in microphone and a handset for telephone-style conversations and greater privacy.

The TriniCom kit can be operated on either a Windows 3.1 or Windows 95-based PC. It requires 16MB of RAM memory. The system also requires a 90MHz (or faster) Pentium CPU, at least 15MB of hard disk space and an SVGA monitor.

## Oracle's Pentium NC raises eyebrows...

Is there a crack in the Wintel alliance? That's what some industry analysts are asking themselves after Oracle announced its development of a Pentium-based Network Computer (NC) that shuts out Microsoft.

Oracle chief Larry Ellison showed off the new NC at the Oracle OpenWorld trade show and conference in San Francisco. The machine is built around a 133MHz Pentium and uses the Intel PCI industry standard for transferring data between hardware and software. The operating system was developed by Oracle and is compatible with Navigator and other popular Web browsers which support the Java language from Sun.

Ellison said several system manufacturers have expressed strong interest in manufacturing and marketing the machine, which will cost around US\$700 at current Pentium prices, excluding a monitor.

Asked why Intel decided to work with Oracle on an NC after ridiculing the idea for more than a year, Intel spokesman Howard High explained that Intel's initial rejection of Oracle's NC program was based on the fact that it involved

outdated low-end processors. Now that the NC effort is shifting to higher-level Pentiums, Intel is naturally interested from a product sales point of view. "Whichever vision of the network computer wins, Intel will be happy as long as we can sell its chips", High said.

Analysts said Intel has to develop a position in the NC market, which could swell as both consumers and corporate intranets adopt the NC as a cost-effective alternative to the PC in a number of different user applications.

In a key endorsement of the NC concept, consumer electronics giant RCA announced at Oracle's OpenWorld expo that it is planning to bring a US\$300 NC box on the market in 1997. The unit will give TV viewers access to the Internet and World Wide Web, e-mail and electronic shopping services.

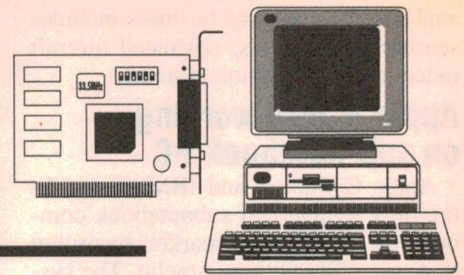
## Pixar produces a 'Profit Story'

Pixar, the computer animation company which — briefly — made a billionaire out of Apple co-founder Steve Jobs, has reported a profit of US\$9.6 million on sales of \$13.3 million.

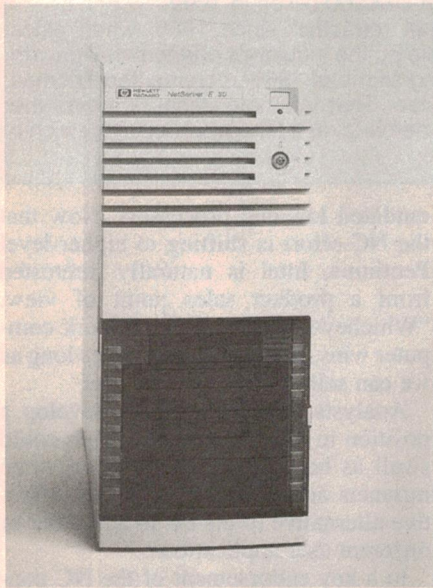
The company, which used its patented computer animation technique to produce the movie *Toy Story*, said it is working on the second of three movies under contract with the Disney company. The next Pixar film will be called *Bugs* and is expected in theatres in 1998. Disney has agreed to pay the full production costs of the next two Pixar movies.

In the meantime, Pixar will continue to rake in handsome royalty fees from *Toy Story*, which was expected to be the top video gift for Christmas 1996. Pixar receives a royalty of between 5 - 10% on the sale of those videos, which could add up to as much as US\$25 million. ♦

# Computer News and New Products



## Easy to use network system



Hewlett-Packard has announced a new series of PC servers, the NetServer E series, for small and medium-sized businesses that have little or no MIS (management information system) support. "HP has taken the fear out of server management by pioneering an extremely easy-to-use line of servers that do not require MIS staff to run them," said David Booth, HP Australia's market development manager for net servers. Booth compared the new servers to HP's laser printers. "As with our printers, when a problem occurs, a message pops up to give advice on how to get your server back up and running."

The new system comes with a guided network operating system (NOS) installation process and a pre-installed network interface controller (NIC). The series is optimised for Microsoft Windows NT Server and Novell's NetWare.

HP has also announced management software developed exclusively for the new servers. To maintain the

NetServer E Series system, the new software — claimed to be the easiest management solution on the market — permanently monitors the system, alerting operators if corrective action is needed, and giving advice on the action required. A traffic-light icon communicates system status: red is a critical alert and yellow is a warning.

The first system in the new series is the HP NetServer E30, which is available with 133MHz and 166MHz Pentium processors; 16MB of ECC RAM, expandable to 192MB; and SCSI-based mass storage, expandable to 21GB. The RRP for the system ranges from \$3500 (inc tax) for a 133MHz Pentium processor-based Model 1 to \$4300 for a 133MHz Pentium system with 2GB of storage.

For further information phone the HP Customer Information Centre on 131347. Information about HP products is on the Web at <http://www.hp.com>.

## Notebook is fast and light

Hewlett-Packard has introduced the HP OmniBook 800 notebook PC, claimed by the company as one of the fastest ultraportable notebook PCs

available. The computer weighs 1.7kg, and has a 133MHz Intel Pentium processor, a 1.44GB hard drive and 26.42cm viewable-image active-matrix display. It measures 3.81 x 28.19 x 18.29cm (HxWxD).

Other features include a SCSI-2 port,

4Mb/s infrared port, 256KB L2 cache, 16MB EDO (extended data out) RAM, an SVGA output (up to 1024 x 768) and one Type III or two Type II Cardbus-ready PC Card (PCMCIA) slots.

The notebook has a set of accessories including a lightweight 4x external CD-ROM drive that uses the notebook's AC adapter. A docking system for the computer includes a slot for an industry-standard, half-length 16-bit ISA card or 32-bit PCI card. The docking system replicates all ports on the notebook PC, including SCSI-2 and SVGA-out and adds a keyboard and mouse port. It also supports 'hot-docking' and Windows 95 Plug and Play, which allow users to dock and undock the notebook while the operating system is running.

The notebook PC comes with a lithium-ion battery, external floppy disk drive and an AC adapter. Pricing ranges from \$5630 (incl. tax) for the HP OmniBook 800CS 5/100, to \$8000 for the HP OmniBook 800CT 5/133.

For further information phone the HP Customer Information Centre on 131347 or visit HP's web site at <http://www.hp.com>.



## Programmable personal information manager

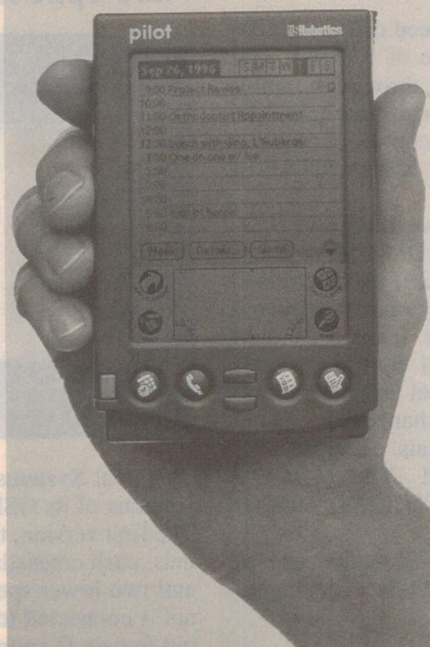
The US Robotics Pilot pocket-sized personal information manager (PIM) fits in a shirt pocket and contains a suite of Windows or Macintosh personal information management applications. These include a date book, address book, 'to do' list and memo pad, all accessed through a touch screen and physical buttons.

Desktop software serves as the gateway between Pilot and desktop applications — for example, a mail merge between the Pilot address book and Microsoft Word.

The Palm Open Systems OS architecture allows other desktop software vendors to build links or conduits between Pilot and their data formats or users can software upload new programs or shareware off the net. The Pilot is C++ and Visual Basic programmable and development kits are available for Macintosh and later for PCs.

The RRP for the Pilot 1000 is \$449, and \$549 for the Pilot 5000. They are available through large chain stores or through Modem Connection resellers.

For further information circle 161 on the reader service coupon or contact



Modem Connection, 113 High Street, Northcote 3070; phone (03) 9482 6557, or email [aasfar@mpx.com.au](mailto:aasfar@mpx.com.au).

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READER INFO NO.30

## MAKE YOUR OWN PCBS



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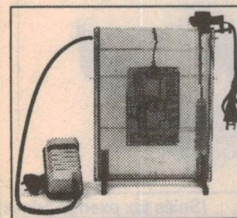
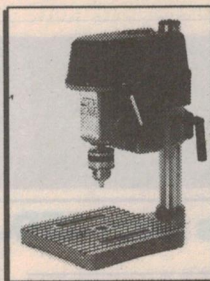
Double sided simultaneous exposure  
Exposure area 380 x 230mm  
Digital timer & display

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### CH-3 PCB DRILL STAND

High speed to 8500 RPM  
Drill press ensures vertical drilling

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### ET10 ETCH TANK

Suitable for ammonium persulphate  
Includes heater & air agitator  
Etch area 200 x 250mm  
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# Computronics

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READER INFO NO.29

## Data logging for the passionate



We know you're passionate about your work, but does it run your life? ... DeLogger Pro will give you time for the other passions in your life.

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Fax (03) 9764 8997 (02) 9971 7995

Internet <http://www.datataker.com/~dtaker>

READER INFO NO.31

## 12x CD ROM drive

TEAC Corporation has released a 12x speed drive, the CD-512. The new drive has a data transfer rate of 1.8MB/s, and features improved durability and reliability through a combination of precision ball bearings, high performance spindle motor and a newly developed disc rotation control circuit that suppresses disc vibration at high speed. It has an MTBF of 100,000 hours (10% duty cycle).

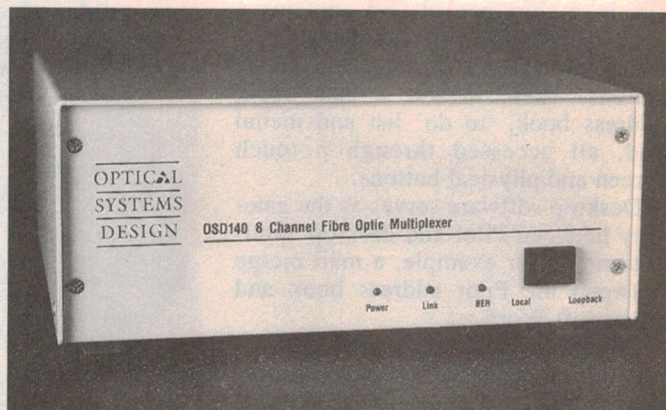
Other features of the drive include a choice of ATAPI (CD-512E) or SCSI-2 (CD-512S) interface, MW DMA Mode 2 and PIO Mode 4 to minimise CPU use (CD-512E) and motorised tray loading. It can be mounted horizontally or vertically and is Windows 95 and Windows NT compliant. It has a standard 5.25-inch mounting format and front panel controls include eject button, stereo minijack and thumbwheel volume control. There is also an emergency CD release mechanism.

The drive is compatible with these formats: CD-DA, CD-ROM (MODE-1, MODE-2), CD-ROM XA MODE-2 (FORM-1, FORM-2) Multi-Session Photo CD, CD-I, VIDEO-CD, CD PLUS, and Enhanced CD.

For further information circle 165 on the reader service coupon or contact Southend Data Storage, PO Box 25, Bangor 2234; phone (02) 9749 2633.



## Fibre optic RS-232 multiplexer



Optical Systems Design has announced the release of two versions of its OSD140 series RS-232 fibre optic multiplexer. The first version, the OSD140D, transmits eight RS-232 channels, each consisting of a high speed (up to 100kb/s) data line and two lower speed (up to 20kb/s) control lines. Each channel is connected to an external computer, printer etc, via a 25-pin female D connector.

The second, the OSD140RJ, transmits eight individual high speed channels and 16 lower speed channels. Each channel is data only and interfaces to external equipment via an RJ12 connector.

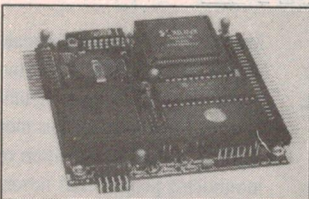
Both units have built-in bit error rate monitoring, link status and fault finding indicators and will operate over up to 5km of commonly available multimode fibres. Units capable of spanning up to 20km of singlemode fibre are also available.

For further information circle 160 on the reader service coupon or contact Optical Systems Design P/L, Unit 7, 1 Vuko Place, Warriewood 2102; phone (02) 9913 8540.

## 720 x 360dpi colour printer

Canon's new BJC-4200 Bubble Jet printer supports the company's new PhotoRealism process, claimed to give outstanding image reproduction. According to Angela Spathis,

## Australian Computers & Peripherals from JED... Call for data sheets.



### Australia's own PC/104 computers.

The photo to the left shows the JED PC540 single board computer for embedded scientific and industrial applications. This 3.6" by 3.8" board uses Intel's 80C188EB processor. A second board, the PC541 has

a V51 processor for full XT PC compatibility, with F/Disk, IDE & LPT. Each board has two serial ports (one RS485), a Xilinx gate array with lots of digital I/O, RTC, EEPROM. Program them with the \$179 Pacific C. Both support ROMDOS in FLASH. They cost \$350 to \$450 each.

**JED Microprocessors Pty. Ltd**

Office 7, 5/7 Chandler Road, Boronia, Vic., 3155. Phone: (03)9 762 3588 Fax: (03)9 762 5499

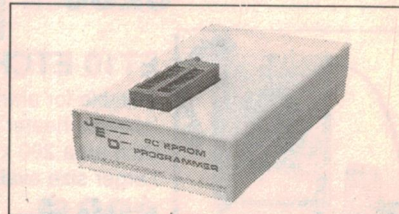
**\$125 PROM Eraser, complete with timer**

**\$300 PC PROM Programmer.**

### Need to programme PROMs from your PC?

This little box simply plugs into your PC or Laptop's parallel printer port and reads, writes and edits PROMs from 64Kb to 8Mb. It does it quickly without needing any plug in cards.

SEE OUR DATA SHEETS AT [www.jedmicro.com.au](http://www.jedmicro.com.au)



(Sales tax exempt prices)

manager of national marketing, Canon Computer Systems and Consumer Products Operation: "For top-quality photographic output on high-resolution paper, just snap in Canon's photo cartridge instead of the standard cartridge. Unlike standard inks, which have a single intensity per pixel, PhotoRealism inks offer variable intensity, with up to four tonal levels per dot. This allows more natural tonal gradation and better contrast — ideal for reproducing the nuances of a colour photograph."

The new printer also provides 720 x 360 dots per inch (dpi) resolution in colour on plain paper, and monochrome printing at up to 4.5 pages per minute. The printer will print on coated and glossy stock, high resolution paper, high-gloss film, back print film, transparencies, and Canon's fabric sheets in washable calicostyle material. It is also compatible with Canon's fluorescent ink.

The printing system incorporates two snap-in ink cartridge/print head units. For four colour printing, it has a 136-nozzle colour print head containing one tri-chambered cartridge with cyan, magenta and yellow; and a black cartridge. A large capacity 128-nozzle black cartridge can be used for fast monochrome printing.

The printer comes with drivers for Windows 95, Windows 3.1 and MS-DOS applications; colour and monochrome ink cartridge/print head units; six built-in fonts and 20 TrueType fonts on disk; and a PhotoRealism CD. An optional PhotoRealism Kit (with photo ink cartridge and high-resolution paper) is also available. RRP is \$649.

For further information circle 162 on the reader service coupon, contact your local Canon dealer or contact Canon Australia P/L, 1 Thomas Holt Drive, North Ryde 2113; phone (02) 9805 2000, WWW <http://www.canon.com.au>.

## NiMH batteries for laptops



Premier Batteries has introduced laptop computer batteries to its range of products. The new line-up of batteries is compatible with Toshiba, Compaq, IBM and Macintosh computers, and incorporates nickel-metal hydride (NiMH) cells claimed to give performance and run times equal to or better than the original product. NiMH batteries are also more environmentally friendly than nickel cadmium cells, and have a higher capacity for a given weight. All batteries are direct replacements for the original product and carry a comprehensive warranty.

For further information circle 163 on the reader service coupon or contact Premier Batteries, 9/15 Childs Road, Chipping Norton 2170; phone (02) 9755 1845. ♦



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### GPS referenced intelligent frequency & time standards

These instruments generate a time scale using a precision ovened quartz oscillator (OCXO) which is periodically locked to co-ordinated universal time (UTC) by GPS satellite-derived signals. Frequency offsets due to temperature and ageing effects are automatically corrected against GPS derived signals. Intelligent profiling optimises corrections and minimises short term as well as long term drift. Long term frequency accuracy 1E-12. Time accuracy ±100 nanoseconds of UTC.



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READER INFO NO.33

# EA DIRECTORY OF SUPPLIERS

Which of our many advertisers are most likely to be able to sell you that special component, instrument, kit or tool? It's not always easy to decide, because they can't advertise all of their product lines each month. Also, some are wholesalers and don't sell to the public. The table below is published as a special service to EA readers, as a guide to the main products sold by our retail advertisers. For address information see the advertisements in this or other recent issues.

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## KEY TO CODING

A Kits and modules

B Tools

C PC boards and supplies

D

E

F

G

Components

IC chips and semiconductors

Test and measuring instruments

Reference books

Note that the above list is based on our understanding of the products sold by the firms concerned. If there are any errors or omissions, please let us know.

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## COMPUTER CONTROLLED STEPPER MOTOR DRIVER KIT

PCB and components kit plus information booklet and IBM software. Includes two stepper motors: **\$44**. Cable and power supply not included.

## LASER POINTERS

Two 5mW at 660nm (very bright!) laser pointers. One a small flat plastic case, the other in a small metal cylindrical case fitted with a keychain. Greatly reduced prices: **\$55** ea

## UV MONEY DETECTOR

Small complete unit with cold cathode UV tube, works from two AA batteries (not supplied). Inverter can dimly light a 4W fluoro tube: **\$5** ea or **5** for **\$19**

## GEIGER COUNTER KIT

Based on a Russian Geiger tube, has traditional 'click' to indicate each count. Kit includes PCB, all onboard components, a Money Detector (see above), speaker and YES, the Geiger tube is included: **\$30**

## PIR MOVEMENT DETECTOR

Commercial quality 10-15M range PIR movement detectors. Second hand, tested and guaranteed, have relay contact outputs, a tamper switch and operate from 12V DC. Compatible with standard alarm systems. Includes circuit: **\$10** ea or **4** for **\$32**

## PIR SENSORS

Dual element Heineam LH1958 sensor plus fresnel lens: **\$5** or **5** for **\$20**

## PIR CASE FOR CCD

Used cases from PIR movement detectors, with Fresnel lens and PCB. Ideal as a case to conceal a CCD camera: **\$2.50** ea or **4** for **\$8**

## PLASMA EFFECTS SPECIAL

Ref: EA Jan '94. PCB and all on-board components (flyback transformer included), and instructions: **\$28**. Amazing results if used with a non-functional but gassed laser tube, available for an additional **\$14** if purchased with the plasma kit.

## RARE EARTH MAGNETS

Very strong!!! Zinc coated. Cylindrical: 7 x 3mm, **\$2** (G37) 10 x 3mm: **\$4** (G38), toroidal 50mm outer, 35mm inner, 5mm thick: **\$9.50** (G39)

## IR REMOTE CONTROL TESTER

Kit includes a blemished fibre optic coupled IR converter tube and our night vision HT power supply kit. The tube responds to IR and visible light, and can 'see' the output of an IR remote control: **\$30**

## LED FLASHER KIT

3V operated 3-pin IC that flashes 1 or 2 high intensity LEDs. Very bright and efficient. IC, two high intensity LEDs and small PCB: **\$1.50** ea, **10** for **\$12**

## SIMPLE MUSIC KIT

3V, 3-pin IC plays a single tune. Two ICs that play different tunes, speaker and small PCB: **\$3** ea, **10** for **\$25**

## MAGNIFIERS - LOUPES

Small jewellers eyepiece: **\$3**, 30mm loupe: **\$8**, 75mm loupe: **\$12**, 110mm loupe: **\$15**. Set of one each of these magnifiers: **\$30**

## VISIBLE LASER DIODE KIT

Redesigned 5mW 660nm visible laser diode kit so the PCB fits into a new hand held case (supplied). Complete pointer kit (with case) at a REDUCED PRICE of **\$35**. A similar kit with a 5mW 635nm laser diode: **\$85** (NEW LOW PRICING)

## STEPPER MOTOR PACK

Pack of seven mixed stepper motors. Save 50%! All new: **\$36**

## POWER MOSFETS

IRFZ44 N-channel MOSFETs at a realistic price. 60V (max), 0.028 ohm on-resistance, 50A (max). TO220AB package: **\$4** ea, **10** for **\$30**

## MINIATURE FM TRANSMITTER

Very small ready-made FM transmitter in a small black metal case. Powered by a 1.5V watch battery (included), has an in-built electret microphone. Tuning range: 88 to 108MHz (adjustable). Range approx 50m: **\$32**

## SOLID STATE PELTIER DEVICES

12V 4.4A, can be used to make a thermoelectric cooler - heater. Basic info included: **\$25** 12V DC fan: **\$8**

## IR REPEATER KIT

Extend the range of existing remote controls up to 15m and/or control equipment in other rooms: **\$18**

## VISIBLE LASER DIODE MODULE

5mW/650nm laser diode module with adj. focus, ideal for making a complete disco laser with other components listed here: **\$70**

## GIANT ONE DAY SALE

In March we will be combining with a major electronic recycling company in a one day sale at a central Sydney location. Offered will be computers, electronic and mechanical components, batteries, motors, optics etc etc. Keep watching our ads for more information.

## ARGON-ION HEADS

Used Argon-ion heads with 30-100mW output in the blue - green spectrum. Head only supplied. Needs 3V/15A AC (for filament) and approx 100V/10A DC for the inbuilt driver circuitry. Power supply circuit provided. Size: 35x16x16mm, weight 6.0kg. 1 year guarantee on head. Needs a 1kW transformer, available elsewhere for about \$170. Argon head only: **\$400**

## HIGH VOLTAGE AC SOURCE

Produces a high frequency, high voltage AC for ionising most gas-filled tubes up to 1.2m long. Can partially light a standard 36W fluoro tube. Includes PCB, small fluoro tube and components: **\$18**

## AUTOMATIC LASER LIGHT SHOW KIT

Three motors, mirrors, PCB and component kit, has laser diode regulator. Can be cased and operated from a computer. Produces a huge range of patterns: **\$70**

## CAMERA - TIME LAPSE VCR RECORDING SYSTEM

Includes PIR movement detector and control kit, plus learning remote control. Combination can trigger any domestic IR remote controlled VCR to start recording when movement is detected, and stop recording a few minutes after movement stops: **\$90**

## CCD CAMERA BONUS SPECIAL



Tiny (38x38x27mm) CCD camera, 0.1 lux, IR responsive (works in total dark with IR illumination).

Connects to any standard video input or via a modulator to aerial input. SPECIAL pack 1: standard or pinhole camera with bonus VHF modulator OR regulated 10.4V plugpack. REDUCED PRICE **\$140** SPECIAL pack 2: pack 1 PLUS video transmitter: **\$155**

## LOW COST IR ILLUMINATOR KIT

Allows a CCD camera or a night viewer to see in the dark. Adjustable power, 10 to 15V operation at 600mA (max). Has 42 IR 880nm LEDs. REDUCED PRICE: **\$30**

## COMPUTER POWER SUPPLY

Standard large supply as used in large computer towers. 5V/22A, +12V/8.5A, -5V/0.5A, -12V/0.5A. Used but in excellent condition. Guaranteed: **\$30**

## STEREO FM TRANSMITTER KIT

FM STEREO transmitter, tuning range: 88 - 108MHz, supply 6-12V, current 8mA (@ 9V), PCB size 25 x 65mm. Kit includes PCB and all on-board components, 9V battery connector, and 2 electret microphones: **\$25**. Plastic case to suit: **\$4**

## WIRELESS IR EXTENDER

Converts the output of any IR remote control unit to a UHF transmission. Tx is self-contained (includes battery), attaches with Velcro strap under IR transmitter. Rx has 2 IR LEDs, and is placed near appliance being controlled. Kit includes two PCBs, all components, 2 plastic boxes, Velcro strap: **\$35**. (9V battery for transmitter not supplied.) Suitable plugpack: **\$10**. Components for 24V: **\$1.50**

## GAS SENSORS

General purpose combustible gas and alcohol sensor, with data: **\$18**

## MIDI KEYBOARD

Quality MIDI keyboard with 49 keys, 2-digit LED display, MIDI out jack. Size: 655 x 115 x 35mm. Computer software included: **\$80** 9V DC plugpack: **\$10**

## VIDEO SURVEILLANCE SYSTEM

A ready made CCD video and AUDIO security system. Includes a small, low light CCD camera in a waterproof case, a 5 inch monitor and a long connecting cable. Monitor has two camera inputs, for manual or auto switching between cameras. Camera has IR illumination and a microphone. Needs 12V/1.2A supply: **\$299**

Computer case and supply (see below) available with this system for an extra **\$10**. Monitor and connecting lead available separately for **\$130**. Note: Our \$130 CCD camera can also be used with the system.

## COMPUTER CASE AND SUPPLY

New, low profile metal computer case with a quality Australian made switch mode power supply: 240V AC to 12V/2A DC and 5V/5A DC. Includes IEC (I/P and O/P) connectors, fuse and switch. Off white, 50(h) x 360(w) x 380 (d) mm. Great for projects, CB power supply etc: **\$20**

## 12V BATTERIES AND INTELLIGENT GEL CHARGERS

Intelligent 'plugpack', 240V-12V gel battery chargers, 13.8V/650mA, proper 'switching' design, with LED status indicator: **\$8.80**

New fresh stock of 12V/6.5AH SLR batteries (Hitachi): **\$33** ea

## DIGITAL RECORDING MODULES

Small voice recording modules as used in greeting cards. Powered by watch batteries (included). Also includes a suitable mini electret microphone. 6 second module: **\$9**

## LARGE VALUE USED ELECTROS

Brands include Sprague, Mallory, Seimens, Mepco, GE. Typical values: 5.4kF-30V, 6kF-50V, 40kF-75V 9.6kF-200V, 3.3kF-200V: **\$3-\$8** ea

## 12V - 2.5W SOLAR PANEL KIT

US amorphous glass solar panels 305 x 228mm, Voc 18-20V, Isc 250mA: **\$22** ea, **4** for **\$70**. Efficient switching regulator kit suits 12-24V batteries & 0.1-16A panels: **\$27**. Simple shunt regulator kit: **\$5**

## MASTHEAD AMPLIFIER

MAR-6 IC-based high performance low-noise masthead amplifier covers VHF-FM-UHF. Includes two PCBs, all on-board components and a balun former: **\$15** for basic kit. Suitable plugpack: **\$6**. Waterproof box for masthead amplifier: **\$2.50**, plastic box for combiner: **\$2.50**

## CENTRAL LOCKING KIT

A complete central locking kit for any vehicle. Good quality, with Mabuchi motor actuators. Can be controlled from existing UHF remote controls. Kit includes 4 actuators, control box, wiring harness, screws-nuts, other mechanical parts: **\$60**. Actuators are available separately: **\$9** ea

## CODE HOPPING UHF CENTRAL LOCKING KIT with UHF REMOTE

Uses code hopping encoder and decoder ICs for ultimate security. Similar to the above system, but has built-in UHF receiver. Includes two matching 2-button UHF transmitters. One button locks, the other unlocks. Receiver has 3 relays: two for central locking and one that's activated in the lock position — for immobiliser etc. Kit also includes 4 actuators, control box, wiring harness etc: **\$109**

## WOOFER STOPPER

Ref SC Feb '96. Kit includes PCB, all on-board components, transformer, electret microphone, one piezo speaker: **\$39**. Approved 12V DC 1A plugpack: **\$14**. NOTE: Works with most wildlife, including kangaroos.

Up to 3 additional piezo speakers with each kit: **\$6** ea. Previous purchasers can take advantage of this offer.

## STANDARD PIEZO TWEETERS

Square, 85x85mm, 4-40kHz, 35V RMS: **\$8**. 67x143mm, 3-30kHz, 35V RMS, wide dispersion: **\$9**

## NEW NICAD BATTERY BARGAIN

6 PACK (7.2V) of 1.2V/800mAh AA NICAD cells, plus a thermal switch: **\$4** per pack (of 6) or 5 packs for **\$16**

Flat rectangular (48x17x6mm) 1.2V 400mAh NICADs with thermal switch: **\$4** per pack or 5 packs for **\$16**

## MISC USED LENS ASSEMBLIES

Unusual lens assemblies from industrial equipment: **3** for **\$22**

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